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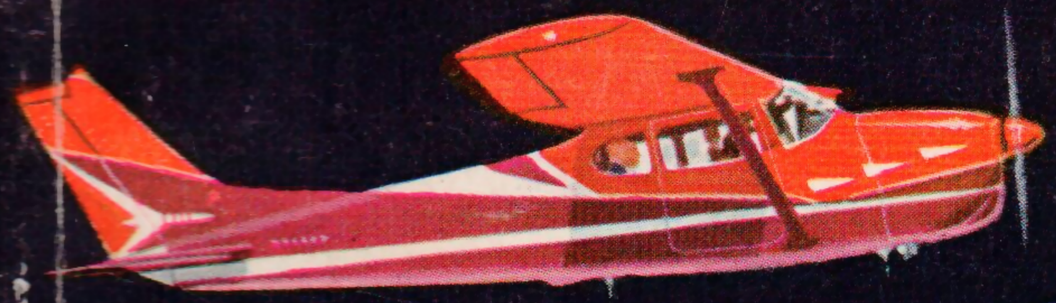

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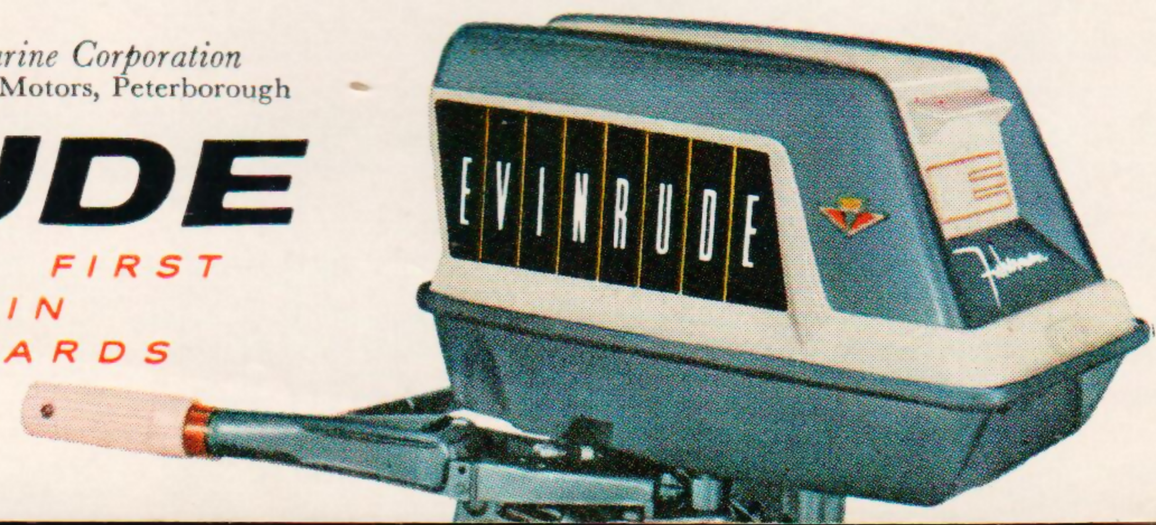

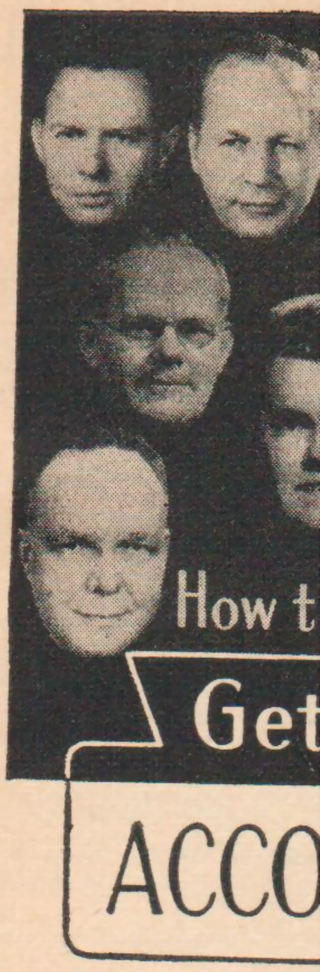

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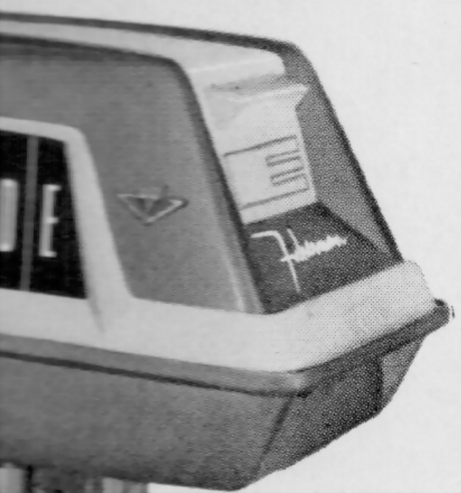

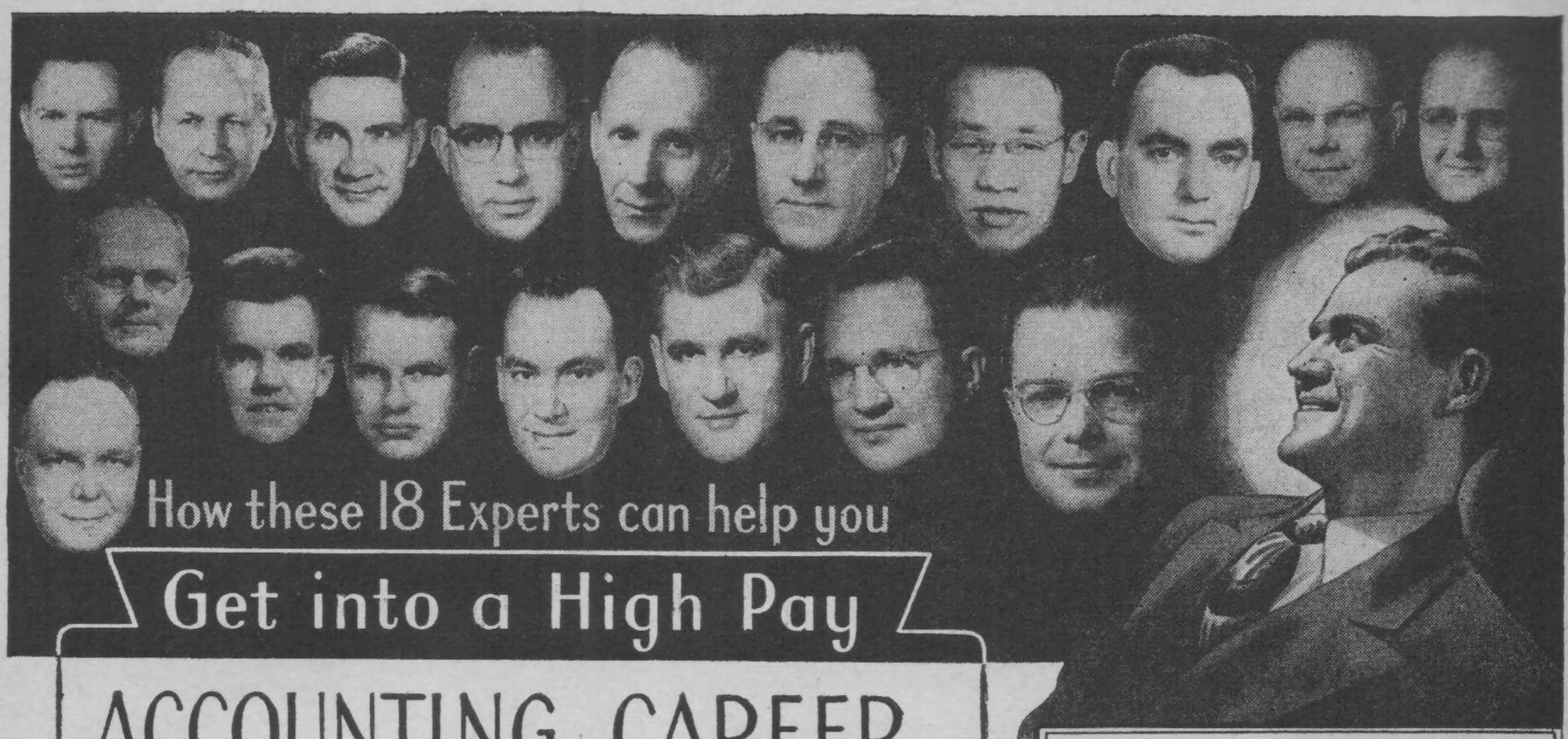

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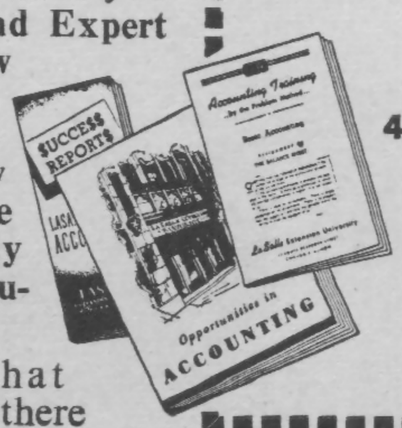

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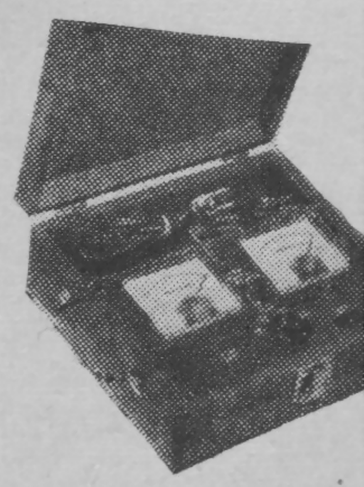

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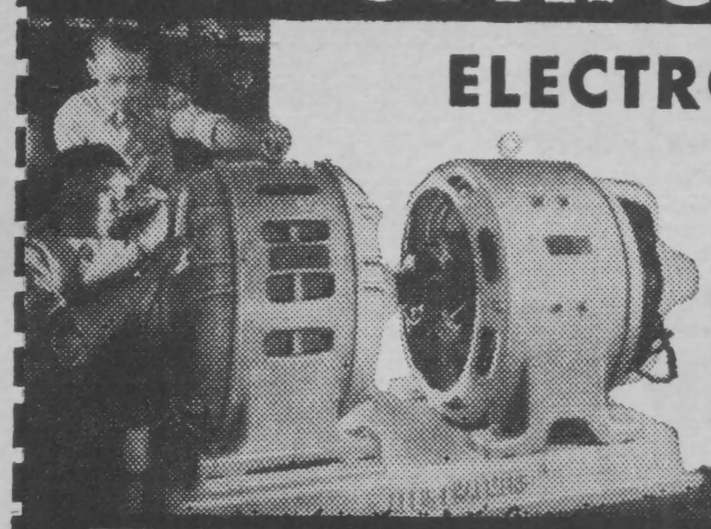

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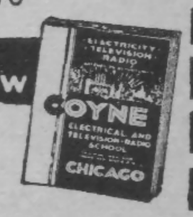

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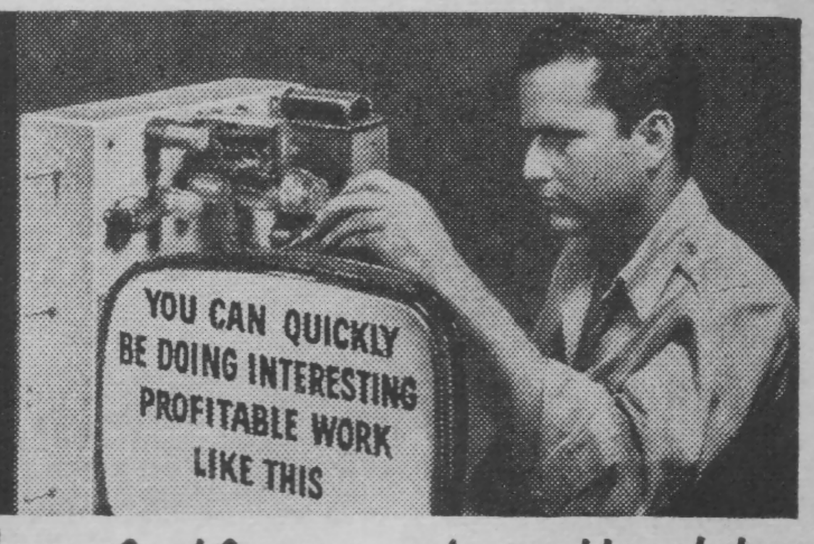

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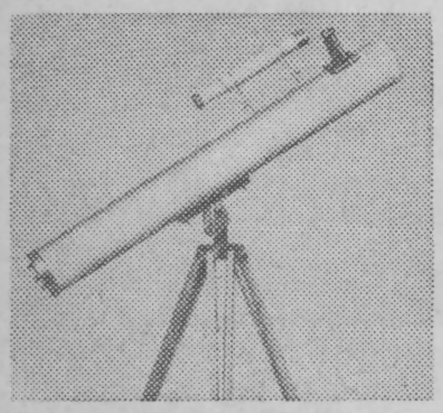

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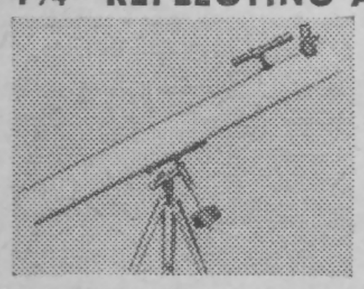

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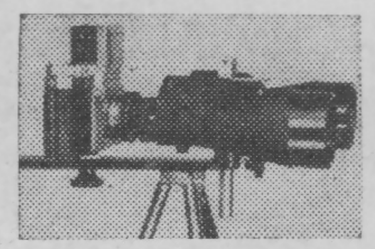

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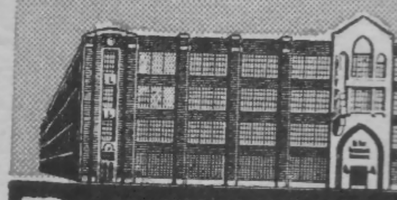

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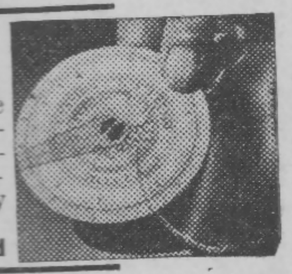
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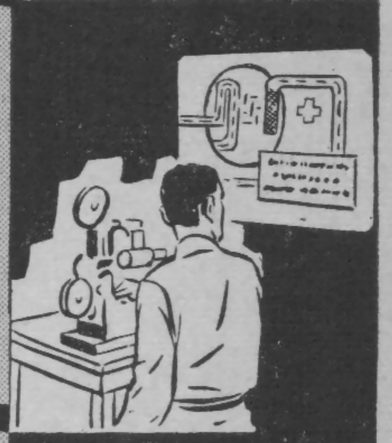

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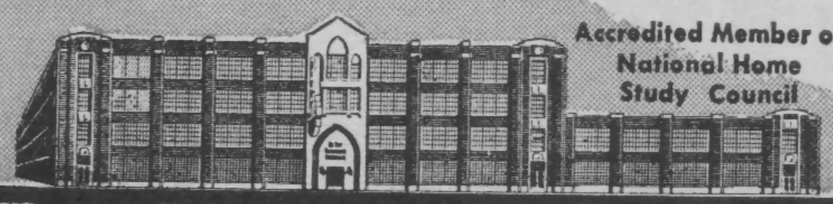

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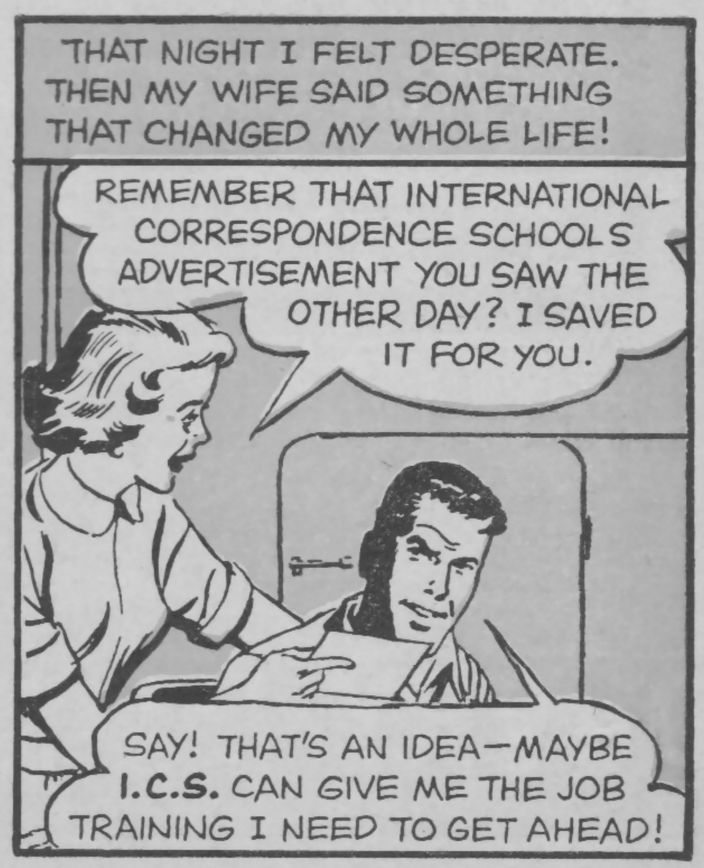

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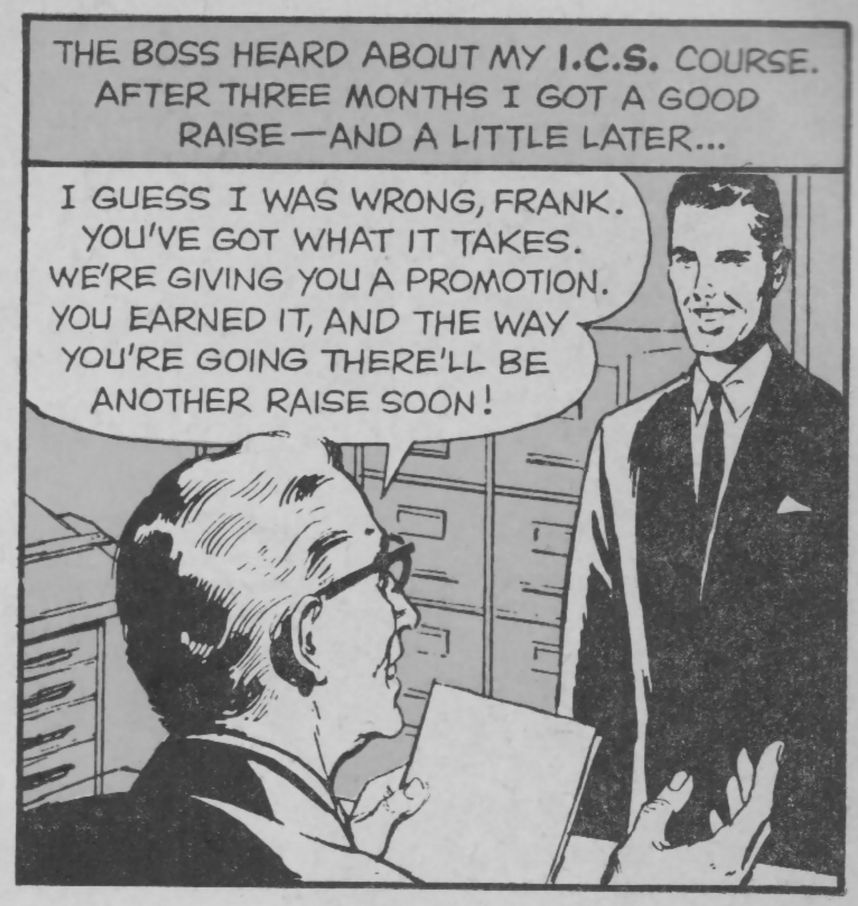

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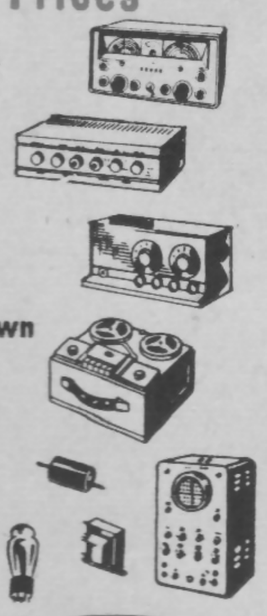

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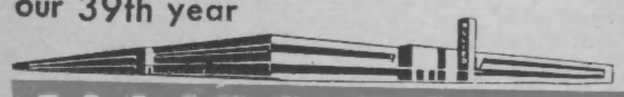

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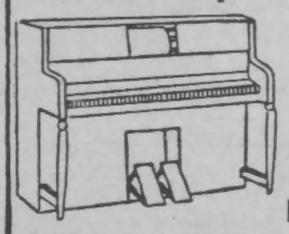
SATISFACTION GUARANTEED! Your money back if you can beat these bargains anywhere! You can't lose so order TODAY for immediate delivery! Send $1.00 deposit on C. O. D. orders. Add 25¢ postage and handling on prepaid orders.

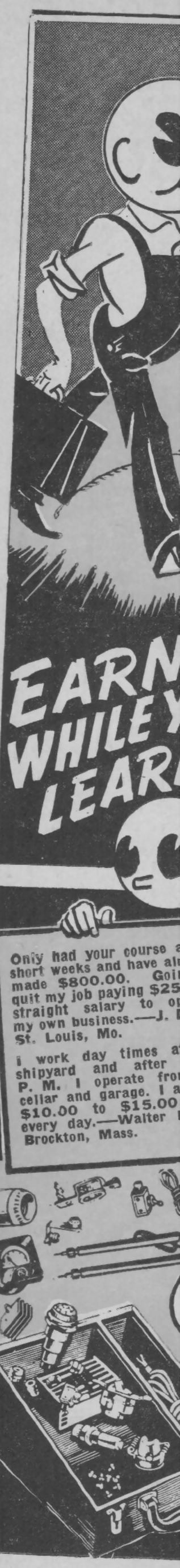
GALCO SALES CO. Dept. 424
7120 Harvard Ave. • Cleveland 5, Ohio

ELECTRIFY PLAYER PIANOS PUMP ORGANS

YOU CAN QUICKLY END TIRESOME FOOT-PUMPING
With a Compact Low-Cost Lee Silent Suction Unit



EASY TO INSTALL
FULLY GUARANTEED
1000'S IN USE
write to
LEE MUSIC MFG. CO.
Box 595, Tujunga, Calif.



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YOU $20 TO $40
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NOW ONLY $19.95
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features of machine tools
E. It planes, rabetts, bevels,
g joints; is so rugged and
unconditionally for ten years.
ALITY FEATURES
nstruction • Balanced steel
and ground knives • Pre-
tables • Rugged cast iron
able 0" to 3/8" • Cast fence
ck • Pat. lift-off aluminum
2" long • Shp. wt. 25 lbs.
Direct From Factory to You
$19.95 CHECK OR M.O.
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ped express collect.
NE & TOOL CO., INC.
4, PENNSYLVANIA

E 75%
ON
K CLOTHES!
CK FROM MIDWEST SUPPLY FIRM!
es you've got to see to believe!
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de to sell for 4 for $2.99
9! Now only
f one! These shirts, though used,
ready for long, tough wear. In
k size, 1st and 2nd color choice.
Unbelievable 99c
w only . . . .
ide leg length. 4 for $3.75
ed and save $2.29
w only . . . 3 for $6.75
conditioned. $1.79
rock-bottom
nent. Now only 3 for $5.00
ED! Your money back if you can
re! You can't lose so order TODAY
Send $1.00 deposit on C. O. D.
nd handling on prepaid orders.
S CO. Dept. 424
• Cleveland 5, Ohio

PLAYER PIANOS
PUMP ORGANS
TIRESOME FOOT-PUMPING
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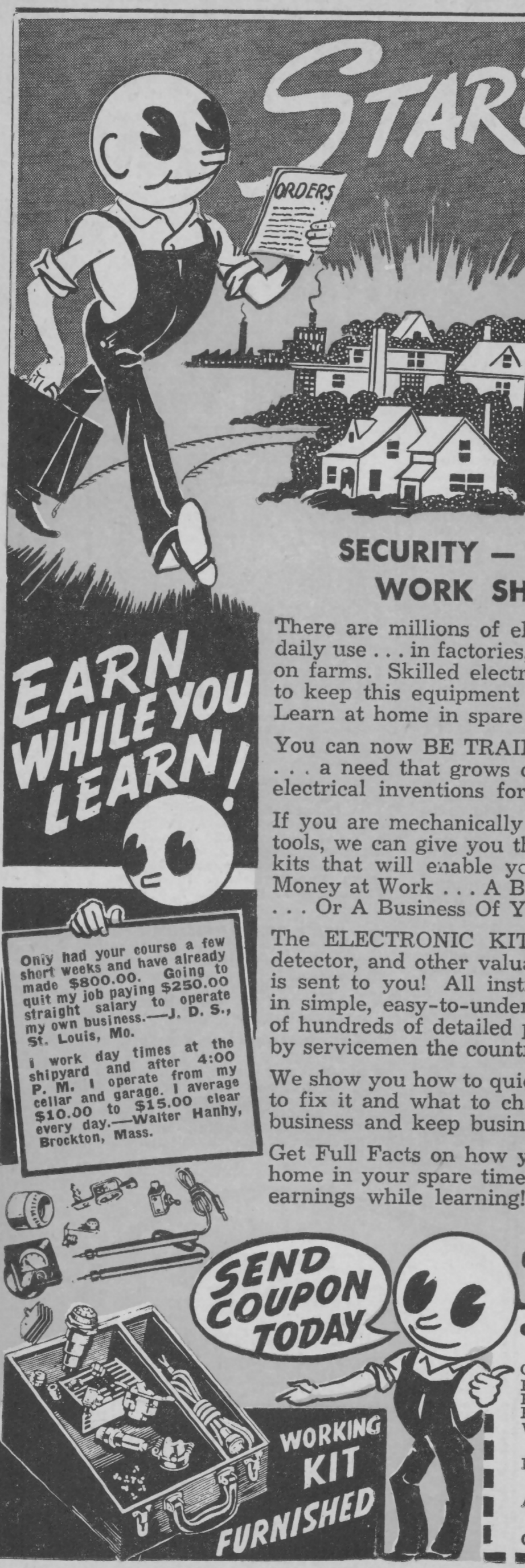
5, Tujunga, Calif.



SECURITY — INDEPENDENCE WORK SHORT HOURS

There are millions of electrical equipment units in daily use . . . in factories, homes, office buildings and on farms. Skilled electrical technicians are needed to keep this equipment in good running condition. Learn at home in spare time.

You can now BE TRAINED to fill this BIG NEED . . . a need that grows day by day because of new electrical inventions for home and factory.

If you are mechanically inclined, can hold and use tools, we can give you the training and time-saving kits that will enable you to . . . Command More Money at Work . . . A Better Paying Job Elsewhere . . . Or A Business Of Your Own!

The ELECTRONIC KIT, a multi-purpose trouble detector, and other valuable Shop Method Training is sent to you! All instruction material is written in simple, easy-to-understand language, chock full of hundreds of detailed photos and drawings. Used by servicemen the country over.

We show you how to quickly locate the trouble, how to fix it and what to charge. ALSO, how to solicit business and keep business coming to you.

Get Full Facts on how you can get this training at home in your spare time and pay for it out of your earnings while learning!

IN YOUR OWN KITCHEN, BASEMENT, OR GARAGE

You don't need elaborate fixtures or expensive equipment to be a successful repairman. Work as many hours as you wish. The Electrical Appliance Technician is his own boss!

$5.00 - $6.00 HOUR

often charged for making ordinary repairs. We show you how to repair refrigerators, vacuum cleaners, washing machines, motors, etc., etc.

AGE IS NO BARRIER

Nor is a minor physical handicap. Work is light, pleasant and PROFITABLE.

FREE BOOK

On America's fastest growing industry

CHRISTY TRADES SCHOOL, Dept. A-202
3214 W. Lawrence Ave., Chicago 25, Ill.

Gentlemen:
Please rush me your FREE ILLUSTRATED BOOK about Electrical Appliance Servicing, facts on your Electronic Kit and Special form for paying later from earnings while learning.

NAME_____ Age____

ADDRESS_____

CITY_____ Zone____ State_____

NEW ALL-ELECTRONIC SOLAR VOLT SUPER-CHARGER
USES THE MILLIONS OF VOLTS WASTED BY YOUR CAR!

NOW! CONVERT ANY CAR ENGINE TO ELECTRIC POWER!

Here's How You Can Drive 1,500 To 3,500 Miles **FREE** This Coming Year!

NO MATTER how new that car of yours is—no matter how much hard-earned cash you paid for it—it is only as good as its ignition system and that ignition system is out-of-date and should have been banned from cars long ago! Why? Simply because the rotor device that distributes electrical tension to your spark plugs uses only the *amperage* that is produced in your car and WASTES millions of *volts* that should be used to aid your spark plugs in firing!

Now — Solar Volt Turns Gas Into A New Superfuel!

A few years ago the U. S. Government granted two patents covering an astonishing electronic super-charger designed to take the place of the old-fashioned rotor. This device, called the Solar Volt All-Electronic Super-charger, adds charges of high-frequency electricity (voltage) to the fuel mixture in all your cylinders — and does it *before* the hot electricity (amperage) arrives at each spark plug to explode the gas-air mixture.

Now, the Solar Volt puts about 14,000 volts of electricity into every cylinder about 10,000 times in every mile you drive! That's *one hundred and forty million volts* breaking up the molecules of your gasoline, making it ignite faster and more thoroughly. Result is instantaneous firing. Actually, you are now operating your engine on a new *superfuel* for power and economy!

What This Means To You

It means you must get *instant* starting even in below zero weather . . . the smoothest idling you ever hoped for . . . freedom from ignition problems . . . instantaneous response to the gas pedal at all times . . . an always cleaner, more efficient, more dependable engine free from knocks, pings and bucking even under the heaviest loads. And—you accomplish all this using only the electronic power every car is now completely wasting!

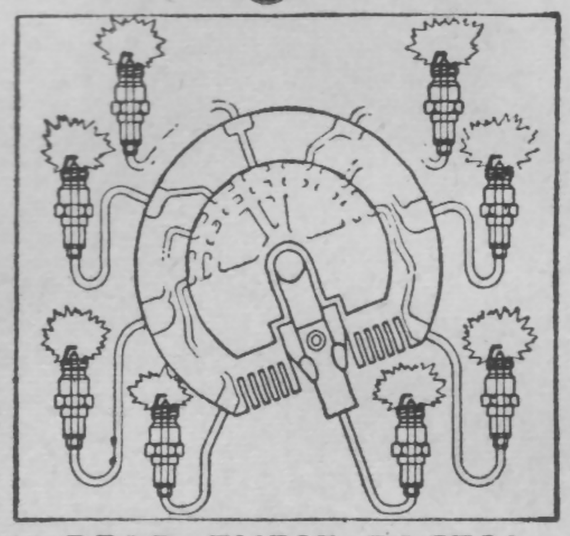
Get Peak Performance In City and Country Driving!

With your present ignition your car should be re-tuned every time you change from city to highway driving and vice versa. Instead, your car is tuned to give mediocre performance on both. But with Solar Volt pouring millions of volts into each cylinder—pre-charging and pre-ionizing that gasoline—you get top performance with any and all driving . . . automatically!

That's why we can guarantee you from 15% to 35% *more power* at any and all speeds! . . . why we can guarantee you will save from *seven* to *sixteen* tanks of gas during this coming year . . . that's 1,500 to 3,500 miles of FREE driving!

Mail the Coupon Today!

The cost of Solar Volt for the make, model and year of your car is only $9.95 complete. You can install it in one minute without a single tool; instantly you will see better starting, feel far greater power, meet the most rugged endurance tests . . . enjoy a saving of 15% to 35% on the gasoline you buy!



READ THESE FACTS!

From the MOTOR EQUIPMENT WHOLESALERS ASSN. NEWS BULLETIN
"Revolutionary gas-saver! Our Studebaker Commander has been averaging 10.2 miles per gallon. After installing the Solar Volt, we got 18.6 miles per gallon in heavy traffic — and 22.5 coming back along the same road in less traffic. Unbelievable as it is, that is an increase of 13.5% to 35.6% in gas mileage!"

From MOTOR TREND MAGAZINE
"A 1957 Chevrolet was giving 19 miles to the gallon and missing under load. After a Solar Volt replaced the original rotor, mileage increased to 21.6 miles per gallon and the car climbed hills without protest."

From AUTOMOTIVE SERVICE DIGEST
"Considerable improvement is evident at engine idling speeds. Engines equipped with the Solar Volt burn clean and fire each charge that enters the combustion chamber. Torsional vibration is minimized, resulting in smooth power flow and less chassis noise."

AUTOMOTIVE ELECTRONICS CO., INC.
31 West 47th St., New York 36, N. Y. Dept. SM-4

Yes, I want to SUPER-CHARGE my automobile for super power and economy! Please send me ..... Solar Volt All-Electronic Super-chargers @ $9.95 each. Enclosed is the full price. I understand that all terms of your GUARANTEE apply.

CAR DATA YR..... MAKE .....

CYS..... MODEL .....

NAME .....

ADDRESS .....

CITY..... ZONE ..... STATE .....

Remittance enclosed: ☐ Check ☐ M.O. ☐ Cash

SOLAR VOLT GUARANTEE

You must be satisfied in every way with your Solar Volt Electronic Super-charger installation or the unit will be replaced FREE.

Copyrighted 1959 by Automotive Electronics Co., Inc. Printed in U.S.A.

ILLINOIS
"Have averaged over $50,000 my first 3 yea Hqtrs' help make it M. Lyons,

You, too BIG IN Boomin

IN YOUR TOWN opportunity right meet the growing de ing of costly carpets . . services for whi are ready to pay go chanical methods be harmful to fabric wide open with our scientific absorpti cleaning. Have you i opportunity? Thous above have, and are the financial securit business. Many hav time and so can you This business is eas quickly established. needed . . you opera and provide all ser customer's homes.

What Manufacturers Sa

". . (Duraclean) standards in keeping with service to which . . carpets and consumer are entitled." —*Avisco* (*American Viscose Corp*)

". . superior to any on-locat process with which I'm familia —*President, Modern Tufting*

". . we approve this process . keeping with better service to M Housewife." —*Aldon Rug M*

DURACLEAN CO., O-

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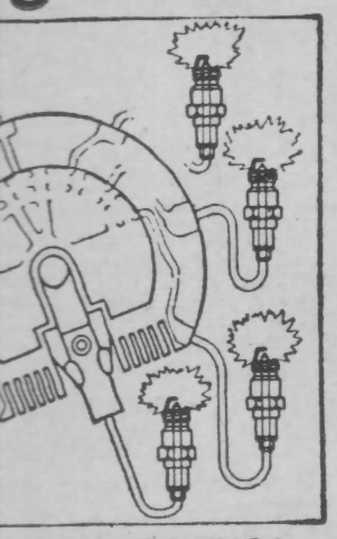

HESE FACTS!

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ASSN. NEWS BULLETIN
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REND MAGAZINE
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improvement is evident
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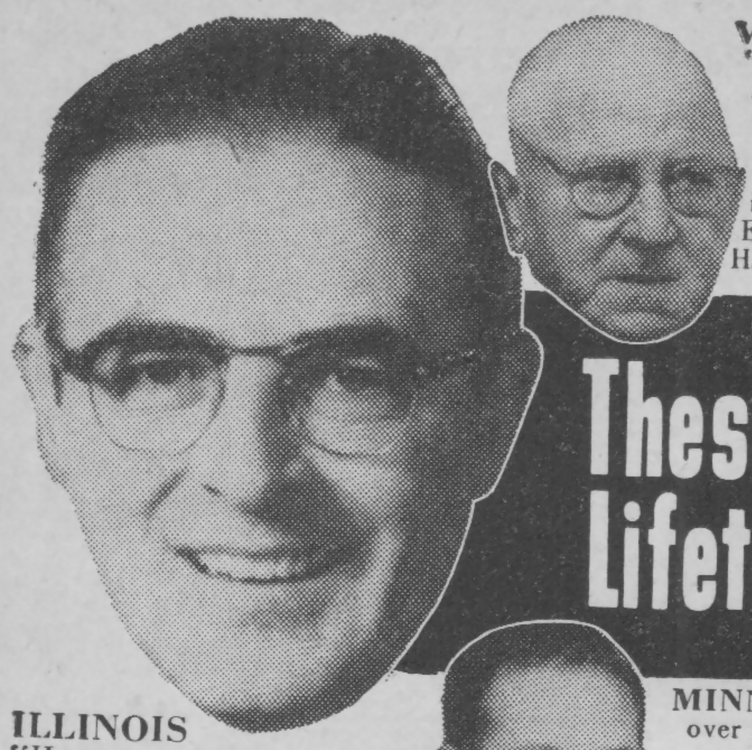

VIRGINIA "My 10th year and business keeps growing. Have made as much as $485 in one day" E. Roddey, Hampton.

CALIFORNIA "Made as much as $347 on just one job. You can't miss with Duraclean" . . . C. W. Morris, Sacramento.

SOUTH DAKOTA "Earned $1571 in a single month. Homeowners here have great need for our services" . . L. Canaday, Rapid City

ARKANSAS "Every person thinks of owning a business. I know of no other which can offer a man so much" . . . E. Bailey, Hot Springs.

These Men are Building Lifetime Businesses!

ILLINOIS "Have averaged over $50,000 my first 3 years. Hqtrs' help make it possible" M. Lyons, Chicago.

MINNESOTA "Averaging over $300 per month part-time. Nothing beats being your own boss" . . . T. Mason, Winona.

NEW YORK "National advertising is tops. One lead from Hqtrs' got me 3 jobs totaling $500" . . . T. Cook, Freeport.

6 WAYS TO MAKE MONEY

You get exclusive use of unique absorption process which cleans carpets and upholstery without harmful scrubbing, soaking or shrinkage. It's acclaimed by housewives, mfrs and backed by McCalls and Parents' Seals. **Five** other profitable services are **soil retarding, mothproofing, flame proofing, spotting** and **carpet repairing.** Thus, on most jobs you multiply profits. *"Headquarters say gross $9.00 per hour. I gross up to $12.00. Many dealers I know do even better,"* says Dan Chilcott of N. Platte, Neb.

You, too, can make BIG MONEY IN THIS Booming Industry

IN YOUR TOWN, there's a real opportunity right now for you to meet the growing demand for cleaning of costly carpets and upholstery . . services for which homeowners are ready to pay good money. Mechanical methods have proved to be harmful to fabrics, so the field is wide open with our exclusive, safe, scientific absorption method of cleaning. Have you investigated this opportunity? Thousands like those above have, and are now enjoying the financial security of their own business. Many have started part-time and so can you!

This business is easy to learn, and quickly established. There's no shop needed . . you operate from home and provide all services in your customer's homes.

We'll train you, show you the proved methods for operating and building your own business, and then back you with 25 continuous services.

By starting now, you will be getting in on the GROUND FLOOR of a $750 million a year industry!

WE HELP YOU GROW

Under our unique cooperative program, you are fully trained through a nearby dealer and at our 50-hour training school. You're kept up-to-date through monthly magazines, nat'l conventions, and at regional meetings where Hqtrs' staff *come to you* in your area. You're backed by nat'l advertising in consumer (McCalls, Parents', House & Garden, etc.) and trade magazines. Others of 25 services which help assure your success include: Individual counseling (staff of specialists give you prompt, expert counsel), ad kits, folders, product development, plus others.

EASY TERMS Moderate payment establishes your own business—pay balance from sales. We furnish machines, sales material and enough supplies to return your TOTAL investment.

ONLY PROCESS TO WIN THESE HONORS

COMMENDED BY THE CONSUMERS SERVICE BUREAU OF PARENTS' MAGAZINE — USE-TESTED BY McCALL'S — AMERICAN RESEARCH & TESTING LABORATORY TESTED CERTIFIED

PROOF OF SUPERIORITY

What Manufacturers Say

". . (Duraclean) standards in keeping with service to which . . carpets and consumer are entitled." —*Avisco (American Viscose Corp)*

". . superior to any on-location process with which I'm familiar." —*President, Modern Tufting Co.*

". . we approve this process . . in keeping with better service to Mrs. Housewife." —*Aldon Rug Mills*

Send for FREE booklets

Free 16-page booklets detail dealership program. No obligations, no salesmen will call. Clip and mail coupon today.

DURACLEAN CO., O-364, Duraclean Bldg., Deerfield, Ill.

"OWN A BUSINESS" COUPON

DURACLEAN CO., O-364 Duraclean Bldg., Deerfield, Ill.

Please rush FREE 16-page booklets which detail how I may own my own business. I understand I am under no obligations and no salesman will call.

Name.....
(please print)

Address.....County.....

City.....State.....

Take the Guess-Work

Enjoy High Pay with a Secure Future in AIR CONDITIONING and REFRIGERATION

Over 20,000 New Jobs Open Each Year

Success is nearer than you think. A good job with high pay and steady work is waiting for you in the Air Conditioning and Refrigeration field. So rapidly is the industry growing that *20,000 mechanics must be trained each year.* Does lack of skill stand between you and opportunity? It need not! You can learn to be a refrigeration technician *at home in spare time.* The CTI plan is practical, fast, sure!

EARN MONEY AS YOU TRAIN —MANY STUDENTS DO

So practical is CTI training that many students soon earn extra cash fixing and installing air conditioners and refrigeration units. Some make service calls independently, while others work for local appliance dealers or air conditioning contractors. A number make service arrangements with meat markets, food stores, dairies, motels, etc. With spare time profits, students pay tuition, buy equipment, and sometimes save enough to bank. And they get experience, too.

START A BUSINESS AND ENJOY INDEPENDENCE

Almost every man wants to go in business for himself. The refrigeration mechanic is in a position to realize that dream. As he makes service calls, he makes friends. In time—provided he does satisfactory work—he will have a list of potential customers. Many shops make service contracts with large users of refrigeration equipment. A shop owner, if he is so inclined, can readily sell, as well as service, refrigerators, air conditioners, etc. A large investment is not required to begin. Sound training, hard work and ambition are the basic requirements.

A Big, Uncrowded Field

Try this for size: Over 150 million units are in use today. In addition, over 6 million new air conditioners, refrigerators and freezers are sold each year. All this equipment needs servicing and repair from time to time. No wonder the demand for trained mechanics is so heavy! "There aren't enough competent service men around," a famous trade magazine reports.

An Easy-To-Learn Trade

Refrigeration Mechanics is a highly respected, major skilled craft. Yet, it is among the easiest to master. Operating principles are simple, free of difficult theory, and understandable by persons with limited educations. There are fewer parts to work with. The craft appeals both to older men who need better jobs in a hurry, and to younger men who seek long-range careers.

New Opportunity Field—Auto Air Conditioning

Over 400,000 air conditioners are to be installed in autos this year, experts say. The field is growing very fast. Already auto shops are advertising for skilled air conditioning mechanics. Opportunities are excellent for starting repair shops. Some day, air conditioners will be standard equipment on cars. Get in on the ground floor.

A BRIGHT FUTURE FOR YOU—BIG EXPANSION AHEAD

Offices, stores, shops, factories, transport systems, hotels—thousands of industrial and commercial enterprises—use the refrigeration principle in some form. New applications are developed almost every day. The future is as big as your imagination. Mail the coupon.

FIRST GET THE FACTS—THEN DECIDE
Mail Coupon Today for 2 Free Booklets

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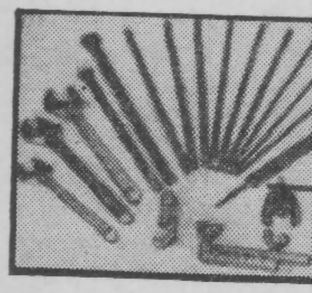

CTI Men Are

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**COMMERCIAL
CHICAGO**

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Open Each Year

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Easy-To-Learn Trade

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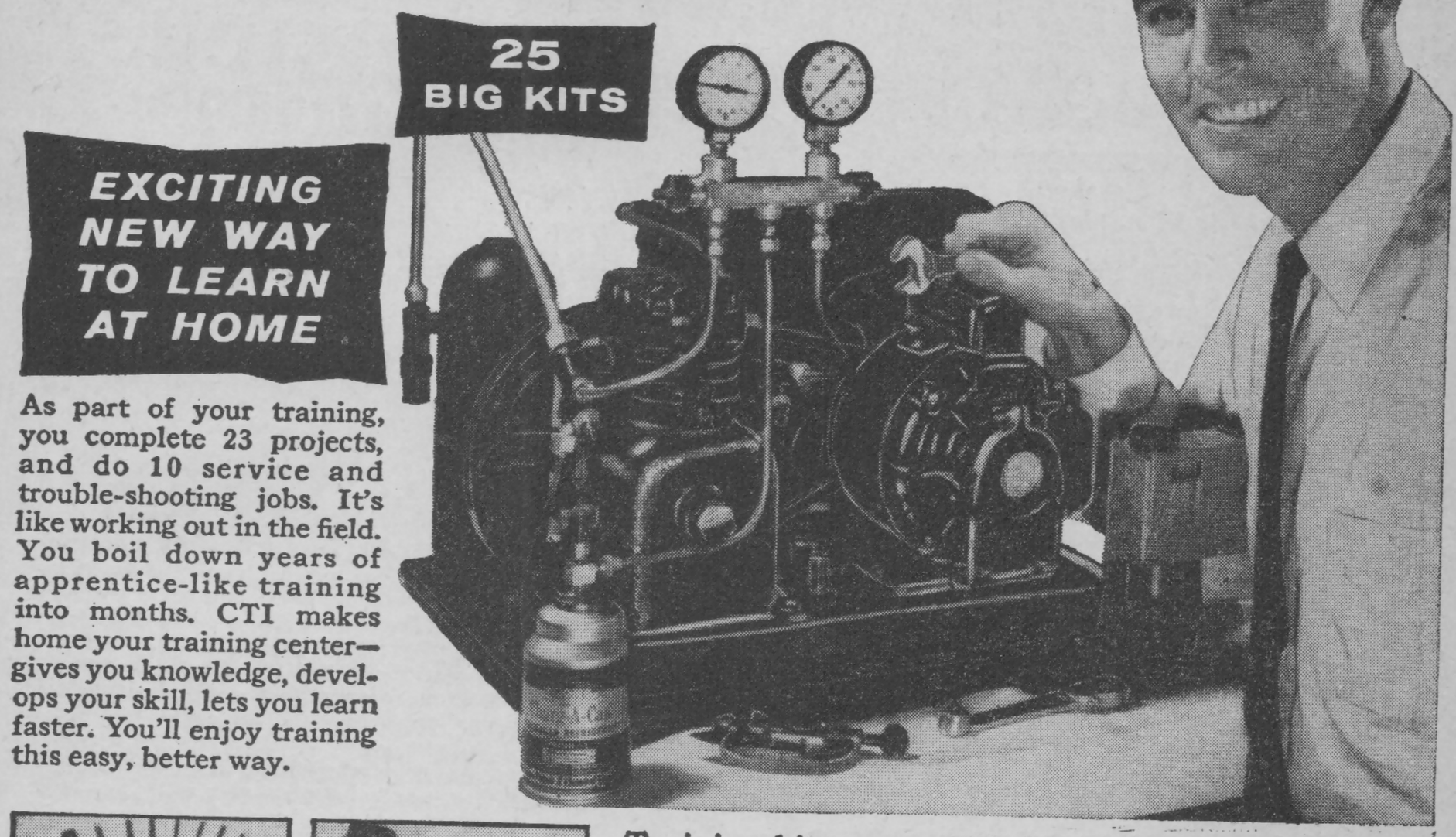
ciple in some form. New appli- ons are developed almost every The future is as big as your gination. Mail the coupon.

THEN DECIDE
Free Booklets

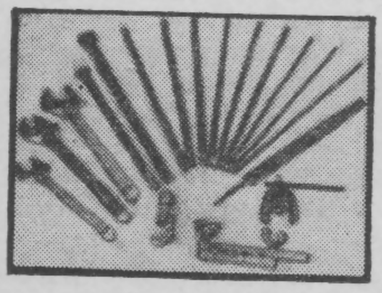
Out of Getting Ahead!

Be a top-pay Refrigeration Mechanic! Learn by practicing—and get experience as you train. CTI sends you 25 valuable kits of parts and tools. You build a heavy-duty, commercial-type, ¼ h.p. condensing unit (illustrated below.) You build an air conditioner, freezer, refrigerator or milk cooler.



EXCITING NEW WAY TO LEARN AT HOME

As part of your training, you complete 23 projects, and do 10 service and trouble-shooting jobs. It's like working out in the field. You boil down years of apprentice-like training into months. CTI makes home your training center—gives you knowledge, develops your skill, lets you learn faster. You'll enjoy training this easy, better way.



Training kits are a CTI "first" in the industry. At left are two of the 25 kits which you will get—at no extra cost. One shows special service tools; the other includes motor, fan, pulley, more tools. Top photo illustrates fully-assembled condensing unit.

CTI Men Are Making the Grade

"I have doubled my income. I do refrigeration repairs in the vicinity."—*Sidney Rappaport, Phila., Pa.*... "Am working for a Frigidaire dealer and am doing most of his repair work."—*Mervin Miller, Sturgis, Mich.*... "I have been very busy. Had an offer to work for an appliance dealer but it looks like I'll be in business for myself before long."—*Frank Fuller, Wells, N. Y.* ... "Am now working in the field. Earn $40 more per month than before."—*Frank Krotzer, Houston, Tex.*... "I not only got a job, but today am foreman, earning $60 a week more than before I enrolled."—*E. E. Hughes, Chicago*... "Have my own business. Only problem is: Too much business!" —*Conrad King, Cynthia, Ky.* You can do as well as these men.

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Send booklet, *Success in Air Conditioning and Refrigeration;* and Sample Lesson. Both FREE.

Name_____ Age_____

Address_____

City_____ Zone____ State_____

Don't be half-trained...

CHOOSE YOUR CAREER IN

Train at home . . . in spare time . . . in one of America's Big 3 industries!!!

SEND FOR YOUR **FREE** OPPORTUNITY BOOK AND ACTUAL LESSON **NOW!!!**

MAKE MORE MONEY...

A Successful Career . . . Security . . . Are Yours NOW in Modern Industry!

Every one of the "Big 3" industries...TV-RADIO-ELECTRONICS...AUTO MECHANICS AND DIESEL...AIR CONDITIONING-REFRIGERATION-ELECTRICAL APPLIANCES...each is growing at a tremendous pace.

Right now is the best time for you to get into the industry of your choice! You can be a part of its growth...you can increase your earning power... you can really build a Successful, Secure Future, filled with all the good things life has to offer!!! Send for information NOW ..TODAY. We'll give you all the facts by mail. There is no obligation on your part...nor will you be inconvenienced...as NO SALESMAN WILL CALL ON YOU!!!

N.T.S. TRAINS YOU RIGHT, FAST AND EASY!

Incomplete "short-cut" training limits your earning power, even disqualifies you for top-pay jobs. N.T.S. gives you training in All Phases...to qualify you for any job in your field...for greater profits all year 'round!

YOUR N.T.S. TRAINING IS BETTER, MORE COMPLETE, LOWER COST!

BETTER...proved and tested in N.T.S. Resident School Shops and Laboratories, by the OLDEST and LARGEST School of its kind in the world. Established in 1905.

MORE COMPLETE...you learn ALL Phases, and you receive EVERYTHING YOU NEED—Lessons, Manuals, Diagrams, many big Professional Kits with parts, tools, instruments for your experimental, repair, service, and trouble-shooting projects. You also receive many valuable training "Extras" to assure your success.

LOWER COST...other schools make several courses out of the material in each one of our MASTER COURSES...and charge you more for *less* training than you get in any one of our "Big 3" at ONE LOW TUITION.

EARN AS YOU LEARN

We'll show you how you can earn money right from the start. Many students pay for their courses—and earn much more—while studying. So can you!

RESIDENT TRAINING AT LOS ANGELES
If you wish to take your training in our Resident School at Los Angeles, start NOW in our big, modern Shops and Labs. Here you work with latest equipment, professionally installed... finest most complete facilities offered by any school. Expert, friendly instructors. Personal attention. Graduate Advisory Service. Help in finding home near school...and part time job while you learn. Check box in coupon for full information.

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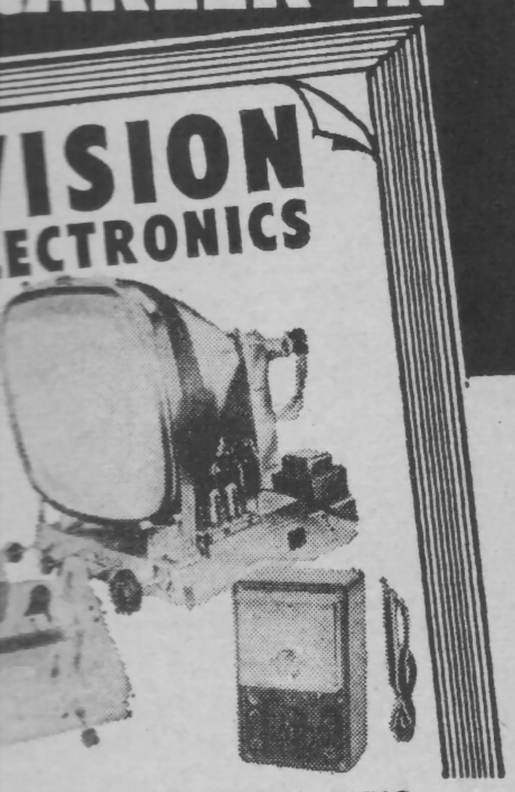

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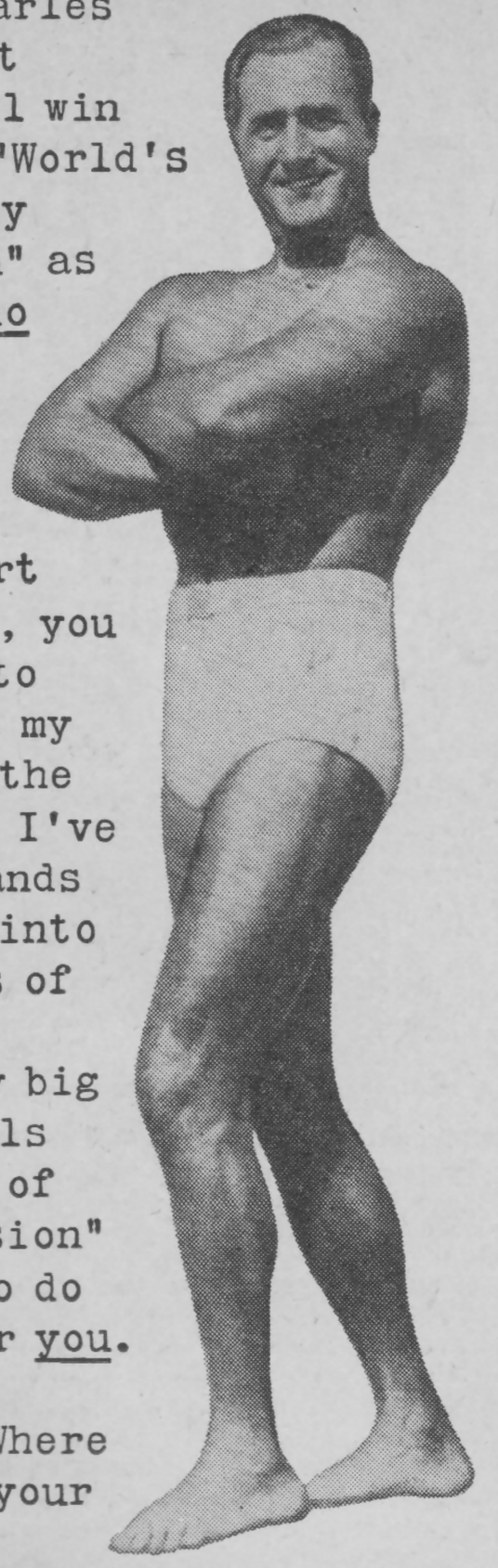

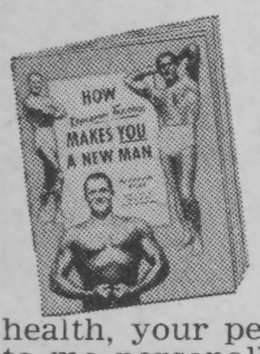

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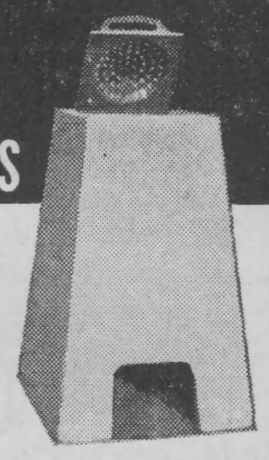

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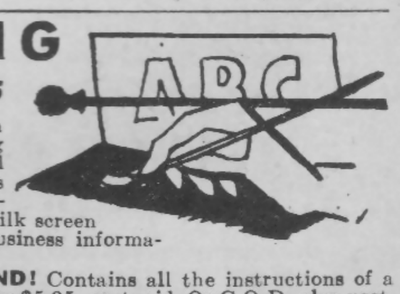

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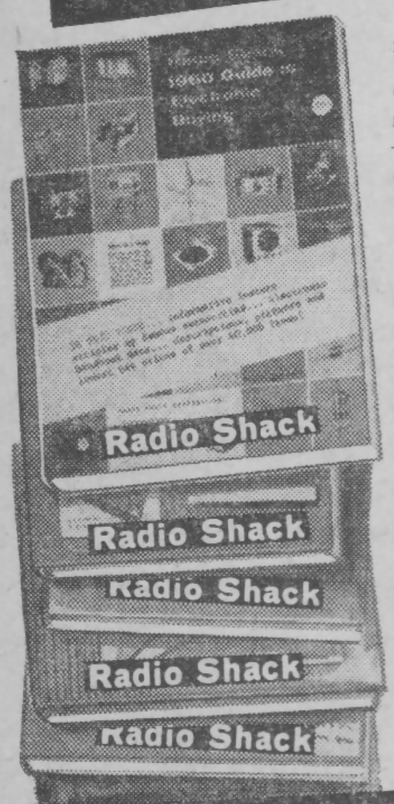

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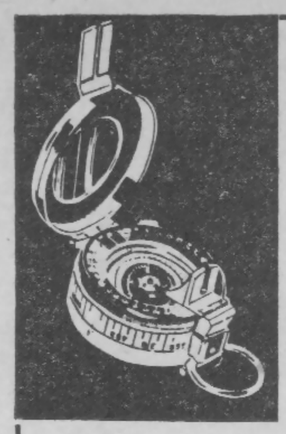

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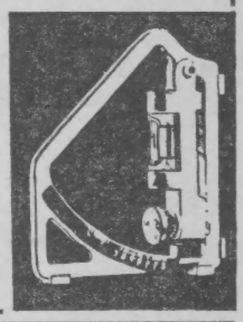

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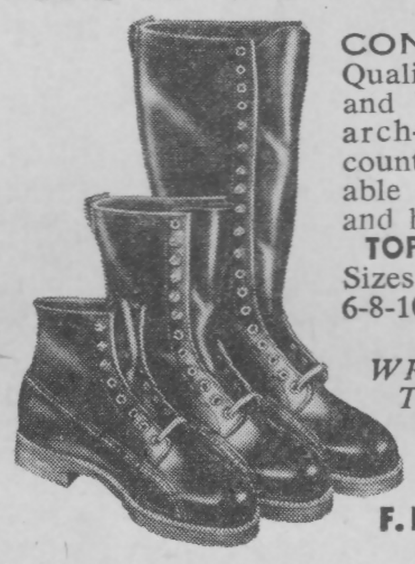

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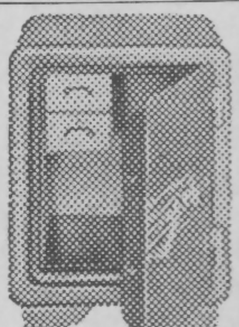

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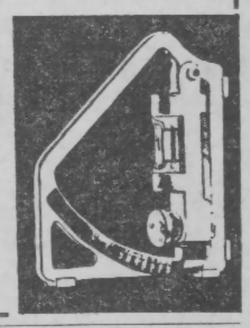

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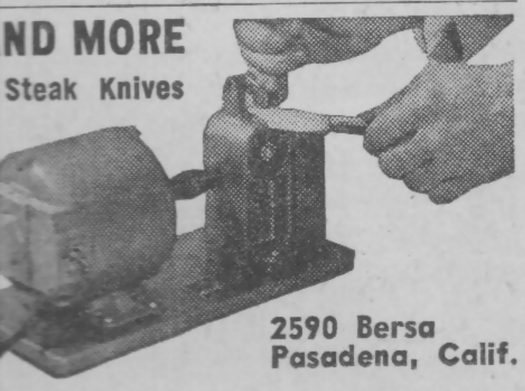

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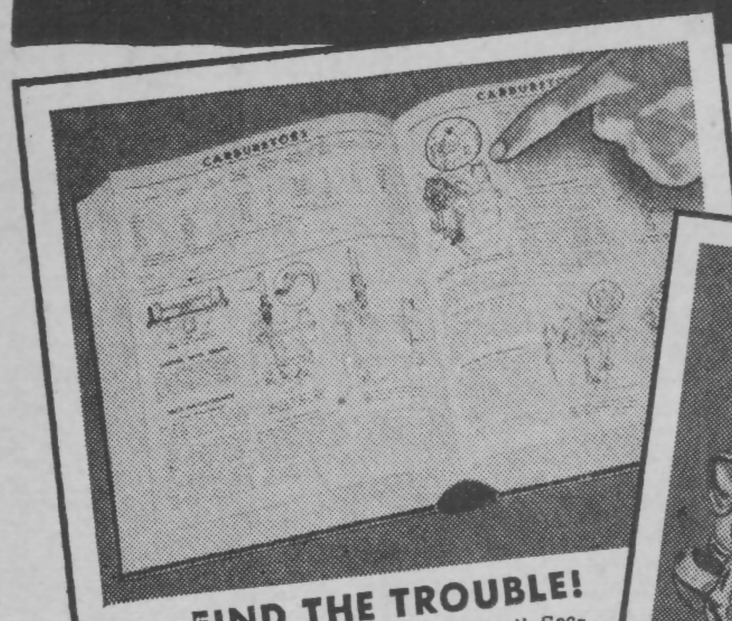

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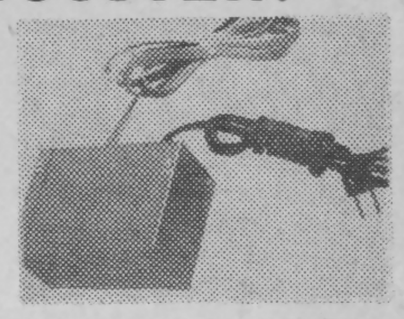

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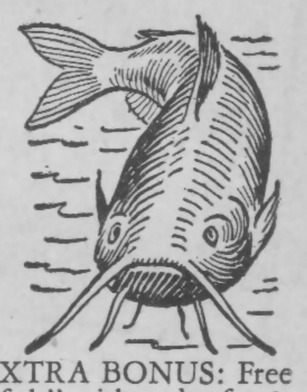

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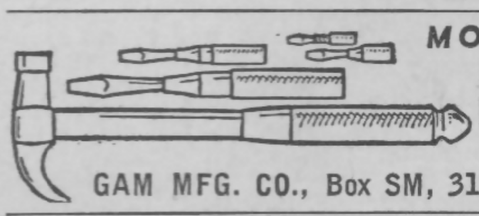

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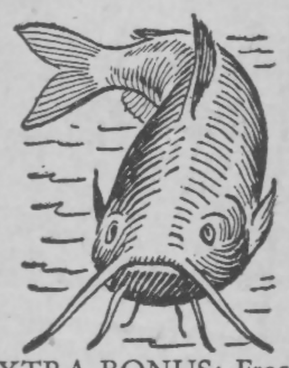

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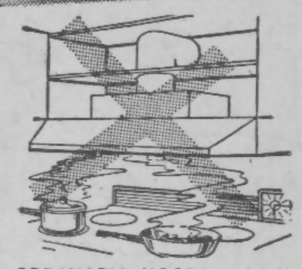

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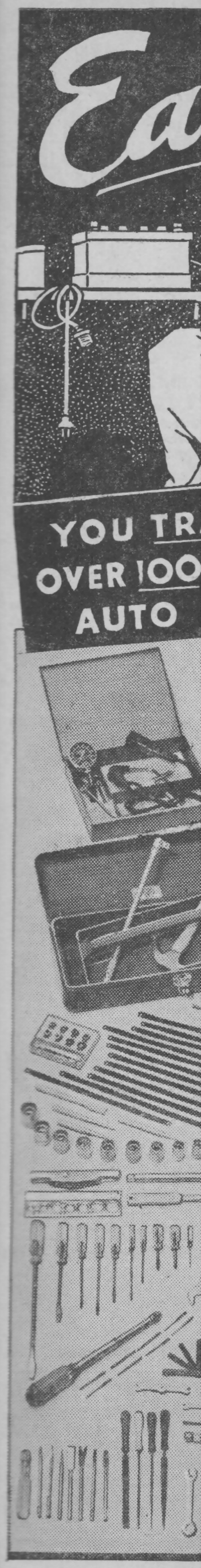

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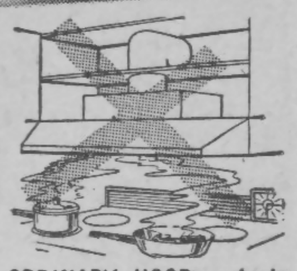

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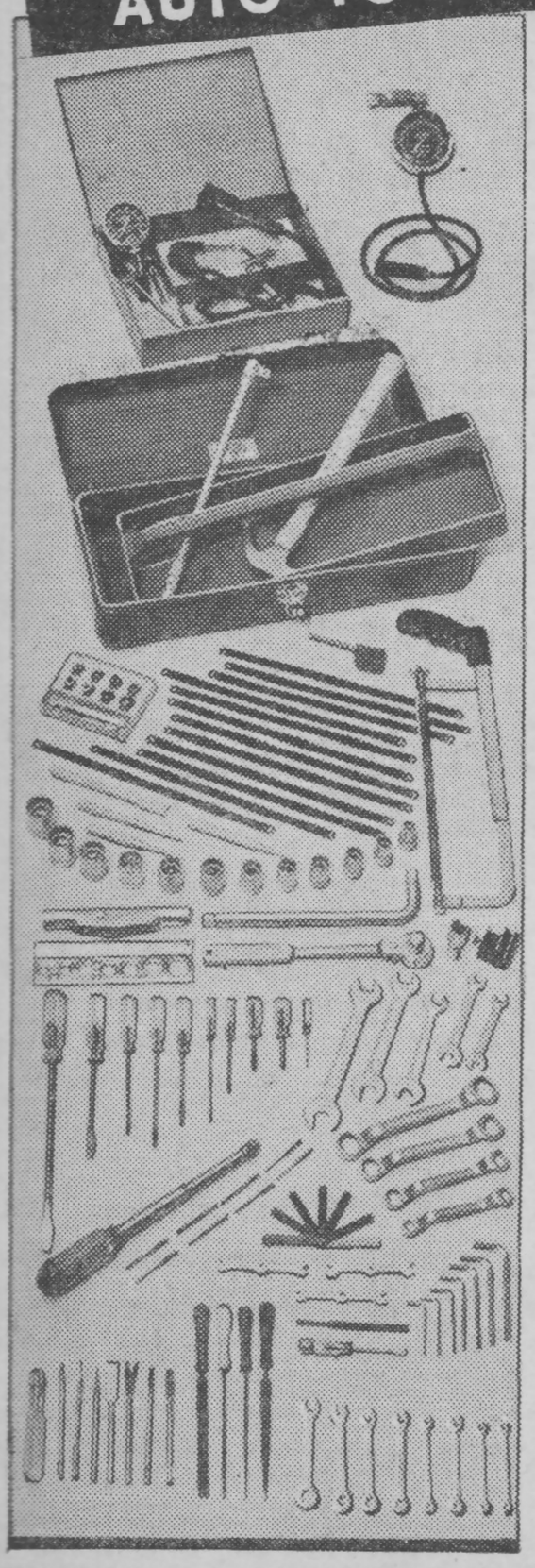
YOU TRAIN WITH OVER 100 DIFFERENT AUTO TOOLS!



Learn AUTO MECHANICS AT HOME IN Spare Time

Start YOUR OWN BUSINESS!

CHRISTY TRAINING IS COMPLETE TRAINING

CHRISTY teaches you the easy-to-remember way. You work with your hands using the professional tools we send you doing motor tune-ups, overhaul, etc. You learn about Automatic Transmissions, 4 Speed Gear Shifts, Electric Cooling and Lubricating Systems, Power Steering, Brakes, Air-Conditioning, Wheel Alignment, Body Repair, Refinishing, Shop Layout, etc. You get motor tune-up specifications for every car for the past 25 years, for foreign cars, too!

YOU EARN AS YOU LEARN

CHRISTY's Home Shop Training Program is designed so you begin earning almost from the very first day. You can work on your own car, increasing its efficiency, gas mileage, etc. You start working in your spare time fixing cars for neighbors, etc. Before you know it, you will be in your own business. Many a large garage owner with a fleet of service trucks started that way just a few years ago.

OVER 100,000 AUTO MECHANICS NEEDED *NOW*

The need for auto mechanics is tremendous because of the many new size automobiles, designs, styles, types of engines, etc. The industry is not keeping pace supplying enough Auto Mechanics for the increasing volume of automobiles on the streets today. This is your opportunity to become independent and earn BIG MONEY.

To do good auto repair work you need good tools and you need enough tools so you can do the job efficiently and QUICKLY.

14 SETS OF PROFESSIONAL TOOLS

including Engine Tune-Up Equipment with highest quality Compression Tester, Vacuum Gauge, Fuel Pump Tester, Ignition Timing Light in a sturdy portable steel case PLUS finest Chrome Alloy tool sets of wrenches, socket wrenches, automatic drills, magnetized screw drivers, Ignition Sets, Allen Wrenches, Files, Extensions as well as needed specialized tools, are sent to you! A heavy gauge steel tool box with removable tote tray is also furnished.

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Everything is included in CHRISTY's COMPLETE MASTER Home Shop course. You learn all about automotive parts and equipment . . . how and why they work, what has to be done to keep cars running and looking like new. You learn short cuts, kinks, time and money saving methods. You will *know* the BASIC *MECHANICAL PRINCIPLES* and be able to fix *all* parts of *all* cars built during the past 25 years, as well as learning everything about the newest, just-being-delivered models.

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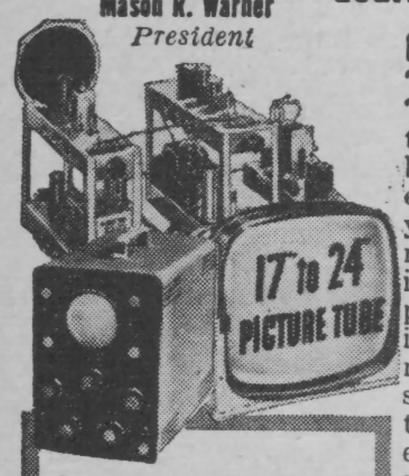

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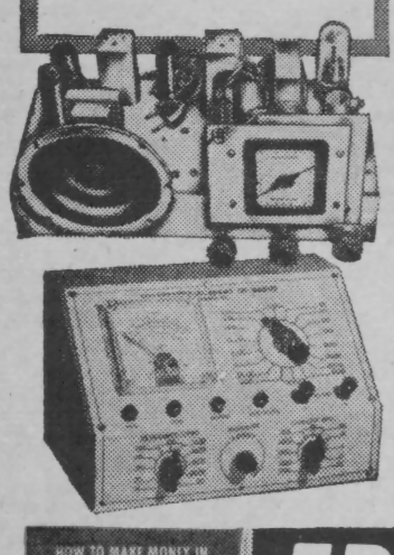

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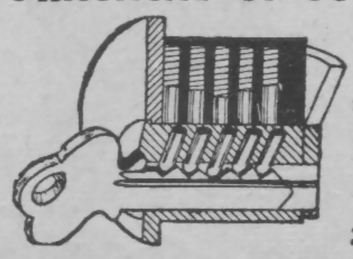

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EVERYBODY'S DO with the VX-6 Demo

The sales fraternity is wild bonanza of profits created by tronic silent salesman. Here a words of praise from practical, producers:

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"My sales now increasing at rate of 300%."

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"Now I'm making more money in less time."

See what hundreds of other $1500 a week—say about VX-6 a mail coupon TODAY!

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We show you HOW.
Start NOW!

THESE BASIC MANUALS CAN BE YOUR KEY TO SUCCESS!

All you need to know to start right in repairing jacks. Easy, step-by-step directions, what tools to use, how to start your own business.

WRITE FOR FOLDER No. SM4 AND FREE BONUS OFFER

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A DOLLAR A MINUTE
IN THE PALM OF YOUR HAND!

FREE SCIENTIFIC NEW ELECTRONIC DEMONSTRATOR

Yours . . . with our compliments . . . the fabulous new VX-6 ELECTRONIC DEMONSTRATOR. . . . greatest asset of the century for the salesman whose TIME IS MONEY! Engineered *exclusively* by NATIONAL DYNAMICS, this mighty midget sales-maker nestles in the palm of your hand . . . works a small miracle before the prospect's eye . . . convinces the toughest customer with INSTANT PROOF! Here's how you light the way to volume sales: Put the Demonstrator prongs in *any* glass of water . . . nothing will happen! Then add a few drops of VX-6 (instantly creating electronic conductivity through the water.) THE BULB LIGHTS UP, yet the water remains safe enough to drink!

IN JUST 30 SECONDS

you will have presented PROOF POSITIVE that scientifically-formulated, exhaustively-tested VX-6 WORKS . . . yet it *will not harm battery!* No technical data, no bulky booklets, no need for either you or prospect to be an electronics expert . . . the Demonstrator does the trick.

When the Bulb Lights, the Sale is Made!

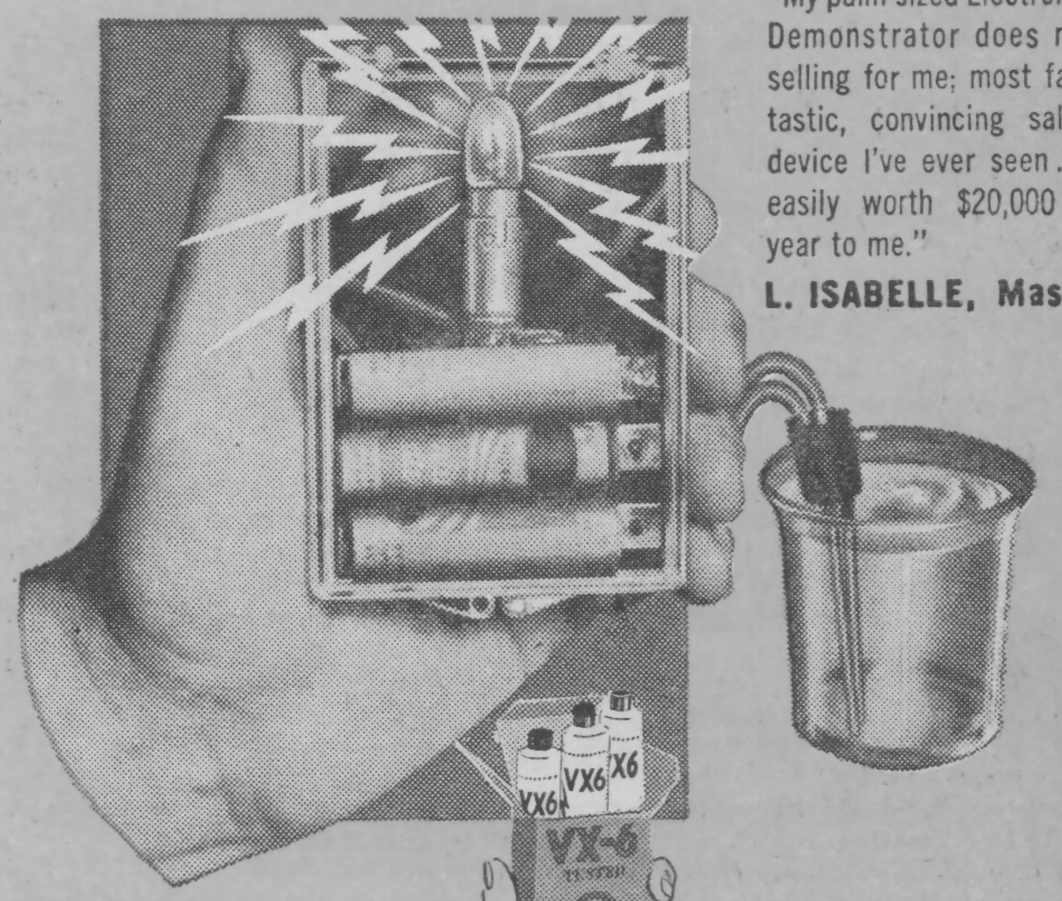
Depending upon how much effort you want to invest, this palm-fitting miracle is

WORTH $60 TO $150 AN HOUR

in profits on your sale of VX-6 . . . because you can make multiple sales to business people as quickly as one-unit sales to individuals; you can close 10 sales where you used to close one! Put this money-making marvel to work for *you* . . . it's FREE with your first order for VX-6.

NASCAR CHAMPION LEE PETTY

Lee Petty, 1959 racing champion and winner of Daytona "500 Mile" uses VX-6 in his racing cars, personal car and even in his farm equipment. "I wouldn't drive without VX-6, and I'm glad to testify to this fact to the motorists of America."



"My palm-sized Electronic Demonstrator does my selling for me; most fantastic, convincing sales device I've ever seen . . . easily worth $20,000 a year to me."

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65 MILLION REASONS WHY VX-6 IS EASY TO SELL!

There are over 67 million cars on the road, and 65,000,000 of them still are prospects . . . all you have to do is give them the FACTS!

NO EXPERIENCE NEEDED

Every car of any kind, any year, model or condition needs VX-6 protection. One application is all that is needed for the life of the car, and immediately old batteries spring back to life. Even new batteries are kept free of sulphation so that they start at their peak of performance always. Sell friends, neighbors, delivery trucks, fleet cabs, company cars and local governments. A single call can mean multiple sales that pay off in hundreds of dollars.

MORE THAN 2,000,000 ALREADY SOLD

to various departments and divisions of

- U. S. Government and The Armed Forces
- A & P, Canada Dry, Chrysler Corp., Coca Cola, General Electric, General Mills, General Motors, National Dairy, Pan-American Airways *and thousands of other business firms*
- & OVER 2 MILLION PRIVATE DRIVERS!

EVERYBODY'S DOING IT with the VX-6 Demonstrator

The sales fraternity is wild about the bonanza of profits created by this electronic silent salesman. Here are a few words of praise from practical, top-notch producers:

A. W. WALTER, Fla. "My sales now increasing at rate of 300%."

JAMES PETERS, Ark. "Now I'm making more money in less time."

A. K. MORRIS, Ga. "Automatic Selling in Seconds; profits prove it to me."

GEO. KATOWITZ, Mo. "I sell company official as easily as my neighbor."

See what hundreds of other big-earning producers—up to $1500 a week—say about VX-6 and the palm-sized Demonstrator; mail coupon TODAY!

LABORATORY TESTED

VX-6 is not an experiment, not an untried product, not a "gimmick" or gadget; it has been exhaustively tested on road and in laboratory. It can be used by anyone, in 60 seconds, without tools or experience; VX-6 is sold with our ironclad, INSURED MONEY BACK GUARANTEE!

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Yes, this is the offer that National Dynamics makes you! Send coupon below for the free, complete VX-6 Sales Kit, big earnings plan, illustrated literature—everything you need to get started at once making good money in your area PLUS INFORMATION ON HOW TO GET YOUR FREE ELECTRONIC DEMONSTRATOR.

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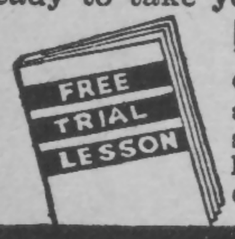

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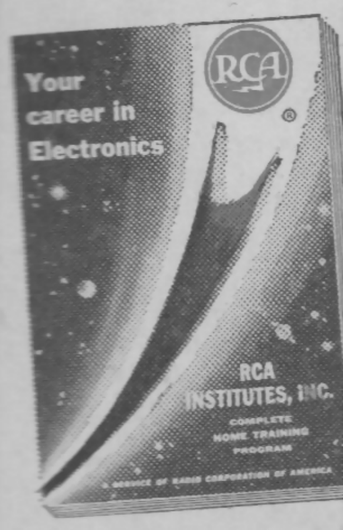

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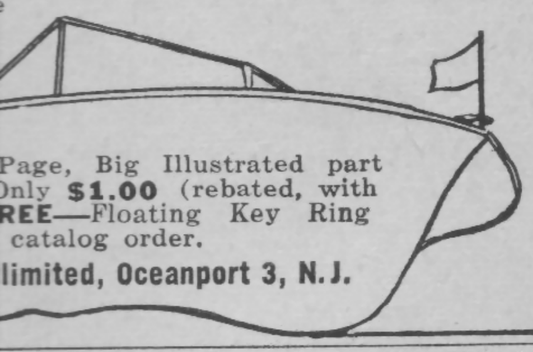

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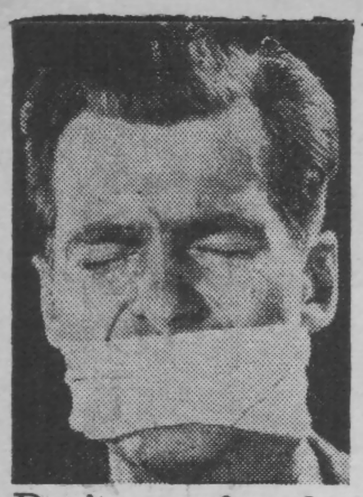

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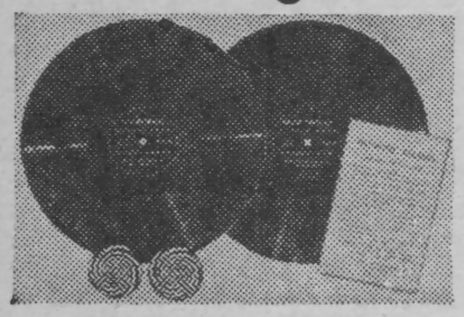

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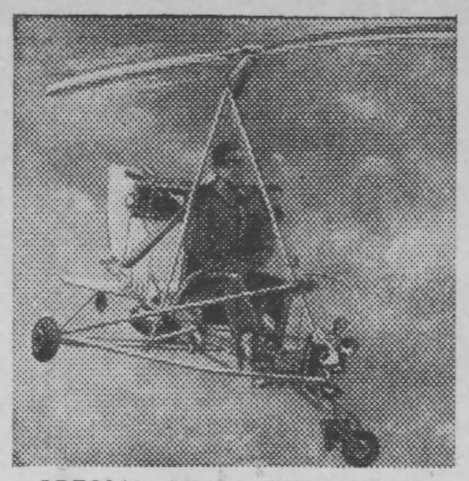

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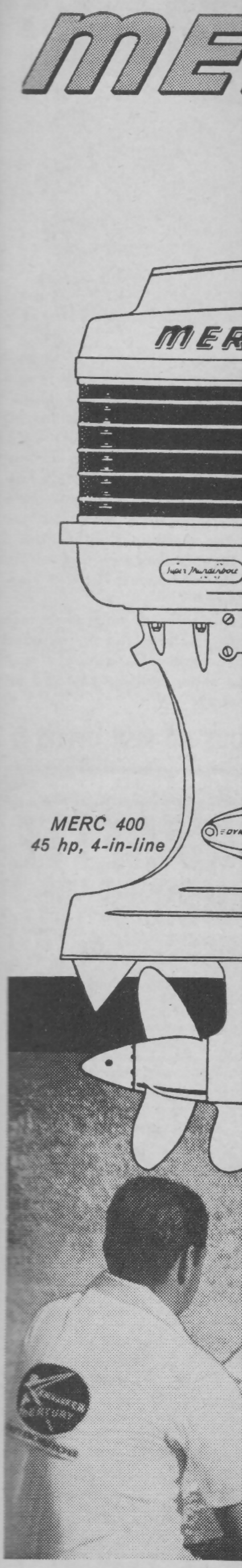

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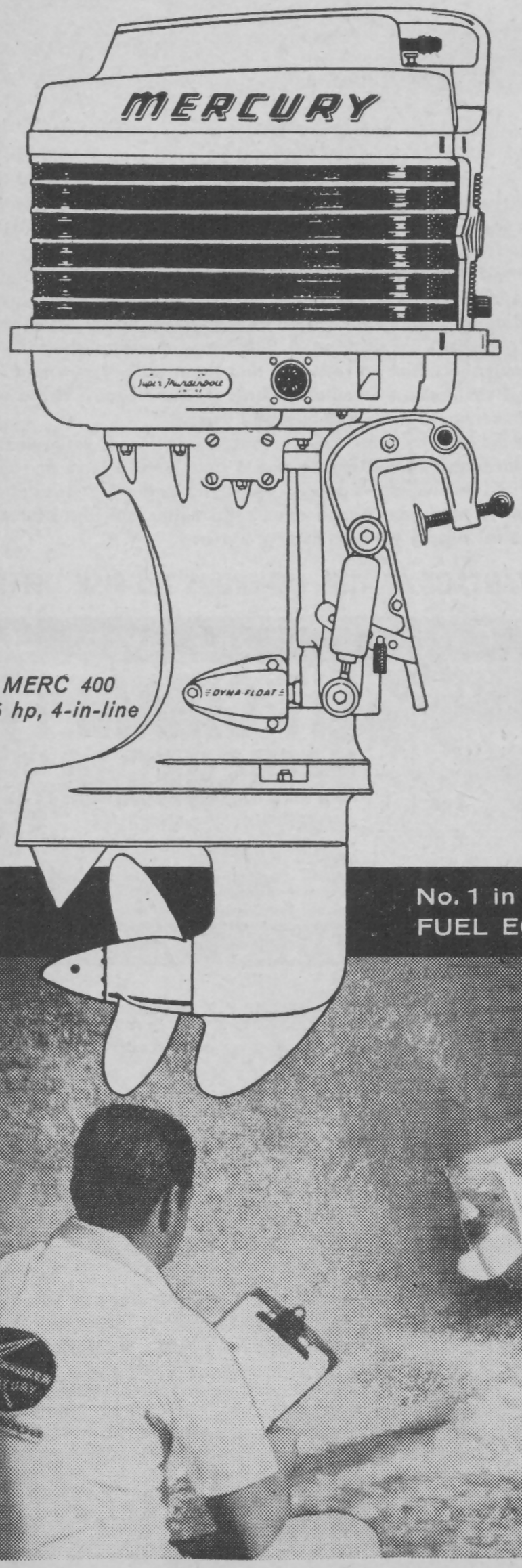

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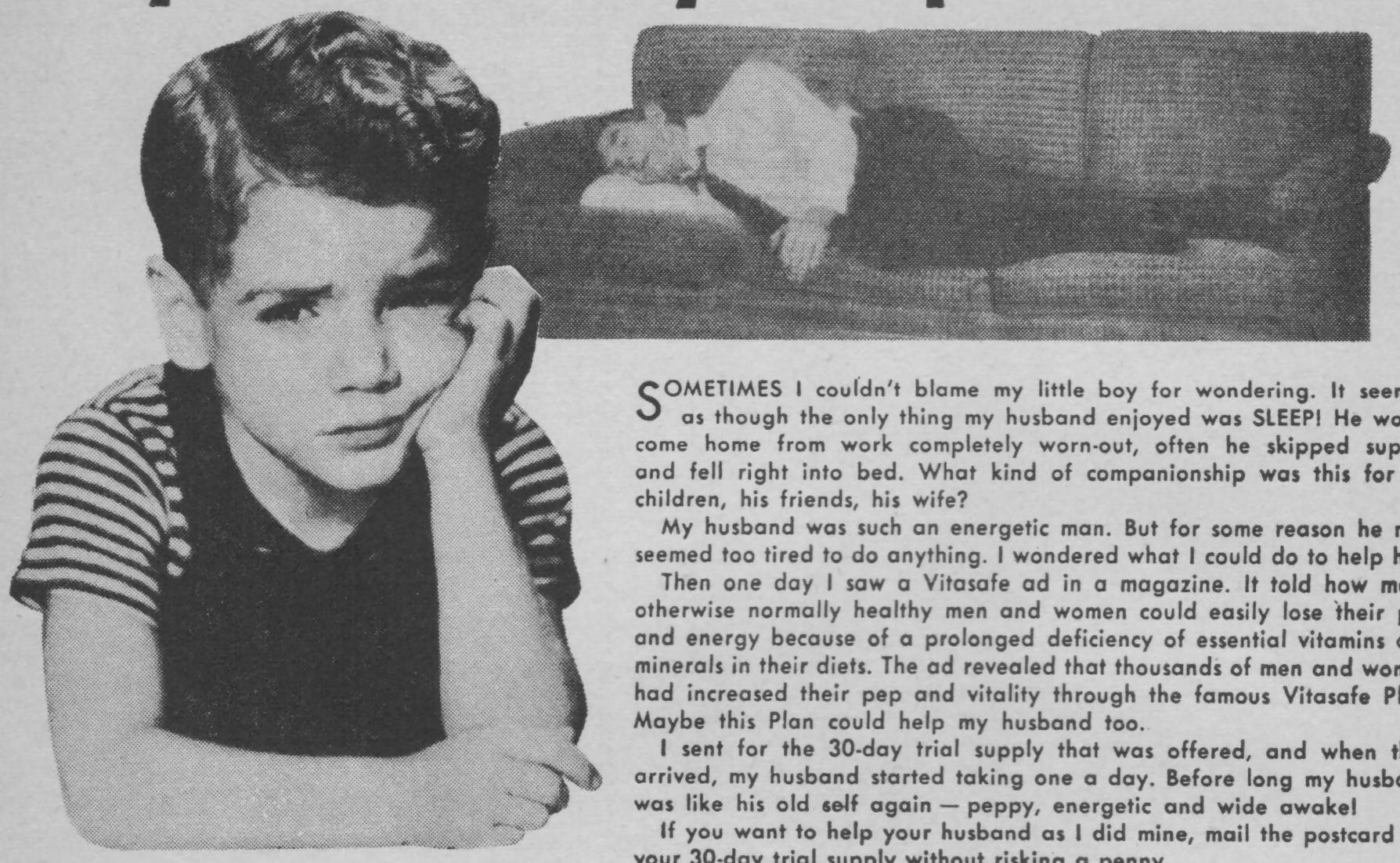

A dramatization posed by professional models.

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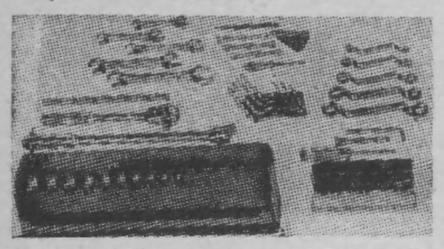

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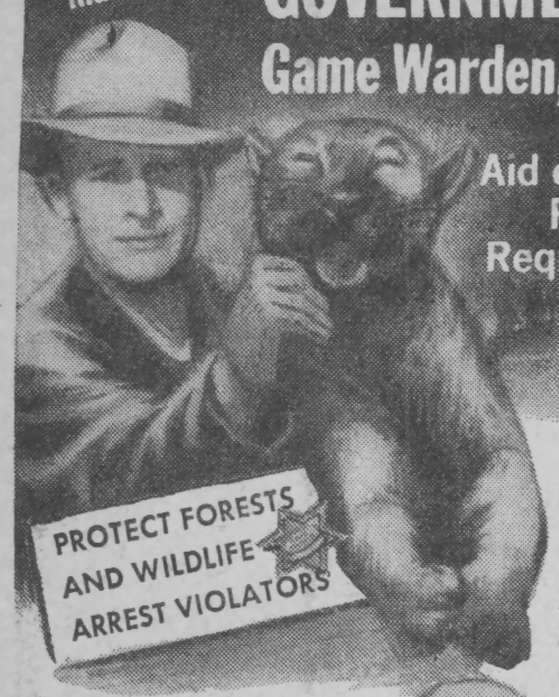

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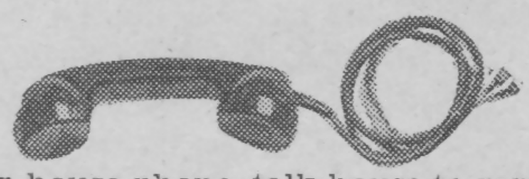

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his answers to the follow
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Question: *What is so*
about a person's
speak and write?

Answer: People judge
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Question: *What do you*
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Answer: A command of
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Question: *But isn't it n*
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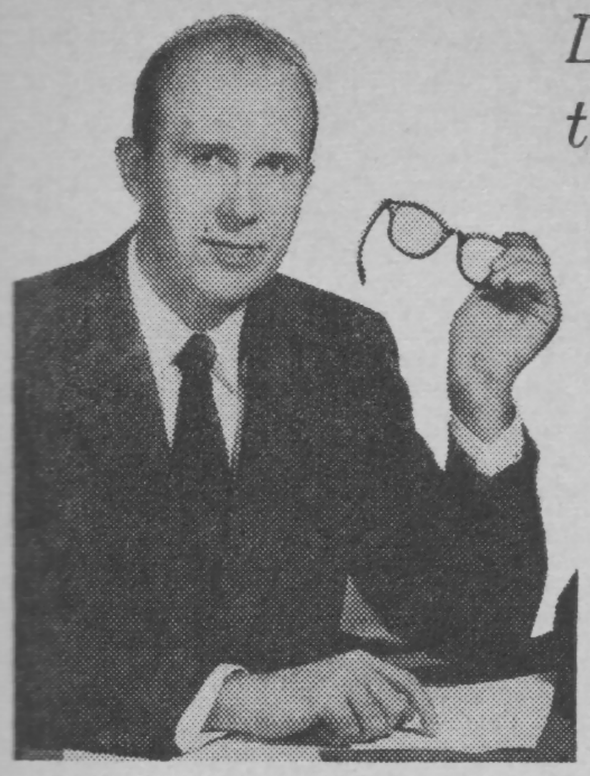

Don Bolander says: "Now you can learn to speak and write like a college graduate."

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DURING a recent interview, Don Bolander, director of Career Institute of Chicago and a leading authority on adult education, said, "You don't have to go back to school in order to speak and write like a college graduate. You can gain the ability quickly and easily in the privacy of your own home through the Career Institute Method." In his answers to the following questions, Bolander tells how it can be done.

Question: *What is so important about a person's ability to speak and write?*

Answer: People judge you by the way you speak and write. Poor English weakens your self-confidence—handicaps you in your dealings with other people. Good English is absolutely necessary for getting ahead in business and social life. You can't win the respect and complete confidence of other persons without a sure command of good English.

Question: *What do you mean by a "command of English"?*

Answer: A command of English means you can express yourself clearly and easily without fear of embarrassment or making mistakes. It means you can write well, carry on a good conversation—also read rapidly and remember what you read. Good English can help you throw off self-doubts that may be holding you back.

Question: *But isn't it necessary for a person to go to school in order to gain a command of good English?*

Answer: No, not any more. You can gain the ability to speak and write like a college graduate right in your own home—in only a few minutes each day.

Question: *Is this something new?*

Answer: Career Institute of Chicago has been helping people for many years. The Career Institute Method quickly shows you how to stop making embarrassing mistakes, enlarge your vocabulary, develop your writing ability, discover the "secrets" of interesting conversation.

Question: *Does it really work?*

Answer: Yes, beyond question. In my files there are thousands of letters, case histories and testimonials from people who have used the Career Institute Method to achieve amazing success in their business lives.

Question: *Who are some of these people?*

Answer: Almost anyone you can think of. The Career Institute Method is used by men and women of all ages. Some have attended college, others high school, and others only grade school. The method is used by business men and women, typists and secretaries, teachers, industrial workers, clerks, ministers, and public speakers, housewives, sales people, accountants, foremen, writers, foreign-born citizens, government and military personnel, retired people, and many others.

Question: *How long does it take for a person to gain the ability to speak and write like a college graduate, using the Career Institute Method?*

Answer: In some cases people take only a few weeks to gain a command of good English. Others take longer. It is up to you to set your own pace. In as little time as 15 minutes a day, you will see quick results.

Question: *How may a person find out more about the Career Institute Method?*

Answer: I will gladly mail a free 32-page booklet to anyone who is interested.

If you would like a free copy of the 32-page booklet, "How to Gain a Command of Good English," *just mail the coupon below. The booklet explains how the Career Institute Method works and how you can gain the ability to speak and write like a college graduate quickly and enjoyably at home.*

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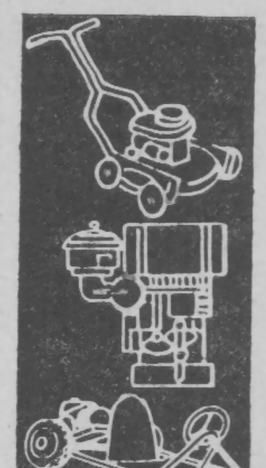

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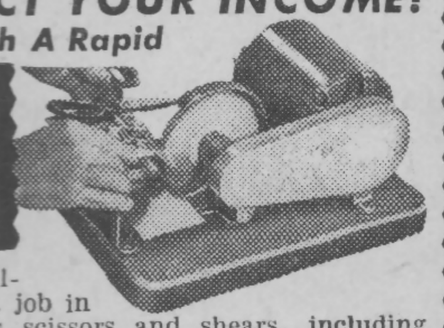
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Find it hard to believe? Perhaps so—but you can verify my statements. When the book arrives, please do this:

First: take a look at page 136 and see 12 different kinds of sideline businesses you can start with almost no capital at all! These enterprises require no specialized knowledge. They are so unusual that almost no competition exists. Yet the need for them is so great that a few people like yourself are now taking in *as much as $35,000 a year from them!*

Second: turn to pages 62-66. Here you'll learn how easy it is to pick up inventories of bankrupt firms at a fraction of true value, then quickly dispose of them at a profit of 200% to 400%. How you can buy up accounts receivables for maybe 10c on the dollar, then collect 60c or 70c on the dollar! How you can act as a middleman negotiating business deals between two firms—and collect a fat commission. Plus other opportunities every bit as lucrative, almost under your nose!

Where to Find Your Private Pot-of-Gold

Take any field, real estate for example. Today, with our exploding population creating a land scarcity, there's no faster way to make a mint. In three fact-filled chapters, this book will show you where to find bargains in real estate. You'll learn how to acquire homes, stores, apartment houses, garages—under the market value, and then make substantial annual profits, or resell at huge profits. You'll see how to make quick profits in land adjacent to railroad tracks . . . filling stations . . . and much more in the same vein.

Just a few words about the stock-market. Please glance at page 51 . . . and discover what is probably the most lucrative, yet most overlooked field of investment in Wall Street. I'll tip you off to an industry where "insiders" are making fabulous gains today. For instance, if you'd put only $100 into Stock "A" two years ago, you'd have $5000 right now . . . and if you'd put that $100 into Stock "B", your money would have mounted to $9500!

And that is not all. Do you know that you can get 12% interest on a 3.6% bond, *and keep your interest tax-free?* Do you know about the astronomical growth prospects in certain special situations? That certain obscure mutual funds have appreciated *two and three times as fast* as some of the better known ones?

Mr. John Alan Appleman specializes in estate planning. He is the author of 36 books, plus many articles which have appeared in top magazines. He has written a two-volume text on estate planning, and articles on legal subjects for the Encyclopedia Britannica.

How to EARN MORE MONEY IN ONE YEAR Than the Average Man Earns in His Whole Lifetime

Would you like to switch careers—get into a field where there's really BIG MONEY to be made? For example, look at wholesaling or jobbing. This is a stable, highly rewarding field. You can start with very little capital. Chapter 8 tells you all about it . . including several specialized areas . . . devote only several hours a week to the business, and still add thousands of dollars to your income.

Want to open a retail store? You'll be told how to select a field with a promising future and build your business to success. Or possibly you've got your eye on manufacturing, insurance, hotel or the restaurant field—contracting or a service occupation. If you go about it in the right way, you can make a fortune in any of these fields.

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You'll find nothing but 100% sound, practical, prudent money-making methods in this book. "How to Increase Your Money-Making Power" gives you the identical methods used by men who have built (not inherited) vast personal fortunes. William Zeckendorf, the real estate tycoon . . . Louis Wolfson, the young "business doctor" who buys, cures and sells ailing enterprises . . . Conrad Hilton, the hotel magnate . . . Burton Hurd, famous stock market analyst and adviser . . . these and other professional money-makers show you the ideas and stratagems which have made them millionaires several times over. And, in addition, in one unusual chapter, you are told the secret of tax-sheltering your gains, so that you *keep what you make!*

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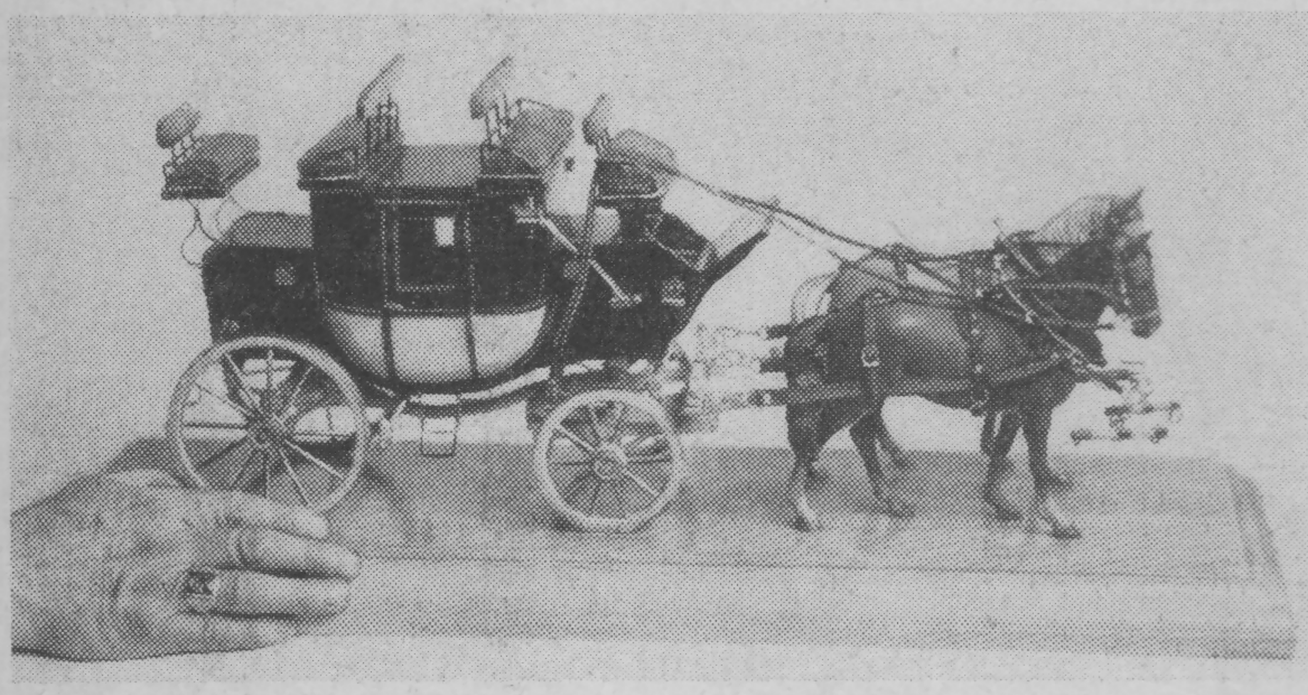


Silver Buckles

Thought you would be interested in this model of the *Tallyho Coach* (Craft Print 45). This beautiful model was built with the aid of your plans, makes a fine conversation piece.

Metal harness parts such as buckles, hames, etc. are made of silver.

Where can I secure plans for other authentic old time vehicles?

Box 154 LYNDON J. GRAHAM
Fairview, Utah

Most of our old-time model plans are out of print, Lyndon. We do have a few circus wagon plans, if you are interested.

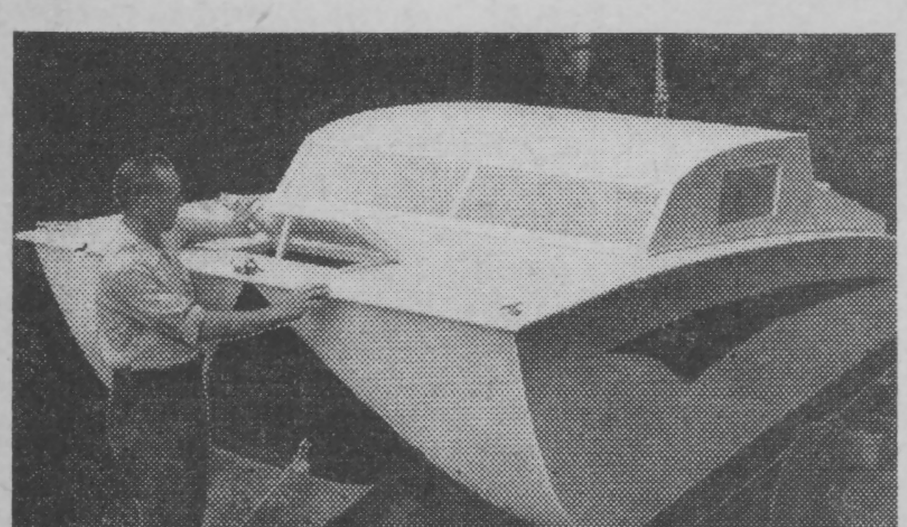
Ventilated Voyageur

I modified your plans on the 18-ft. *Voyageur* (Craft Print 261) to change the hatch from the top to the front deck. This gives better ventilation and does not interfere with the space. I made my own transom bracket and eventually powered it with two used 22 *hp* Evinrudes.

The boat performed very satisfactorily and I have received numerous inquiries re where to obtain the plans.

WILLIAM F. CANEDY
6 Southern Avenue
Greenfield, Mass.

You hatched a really cool idea when you thought up that ventilation change, Bill.



Non-Banking Stingaree

Enclosed is a snapshot of *Stingaree* (Craft Print 289). Cost me about $125.

With a 20-*hp* Mark 25, she moves about 27-30 *mph*. On high speed turns she jerks around corners instead of banking. I also built *Minimax* and I am starting on *Doodle Bug*.

15712 Fernway Drive TOM GOODING
Maple Hts. 37, Ohio

That's the first report we've had on this boat indicating any jerking action on the curves, Tom. We'll ask Bill Jackson to write you about it.

Avid Builder

Have been an avid reader of S&M for more years than I can remember, but until now I have never put in my two cents worth.

In 1954 I built your *Swift Swoose* (Craft Print 199). With a 25 *hp* Evinrude, it clocked 49.8 *mph* (there was hardly anything around here that could keep her in sight for long). In 1956 I built your *Playboy* (Craft Print 201)—also a good performer at 31 *mph*. Last year I built this *Sea Babe* (Craft Print 210) which

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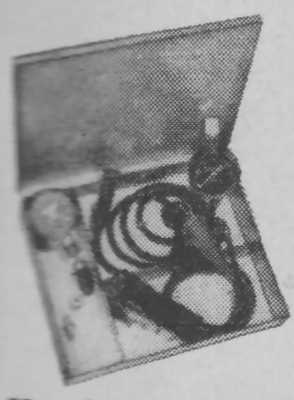

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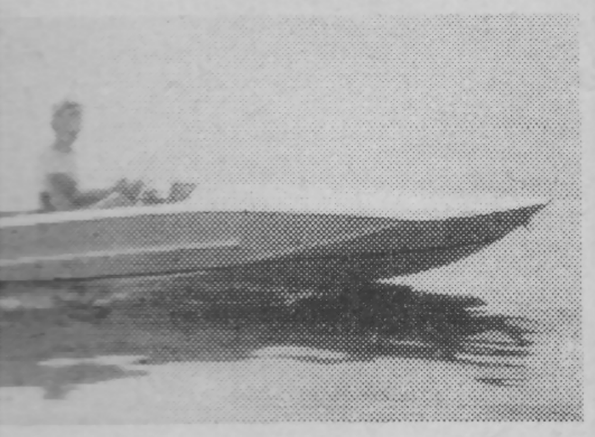

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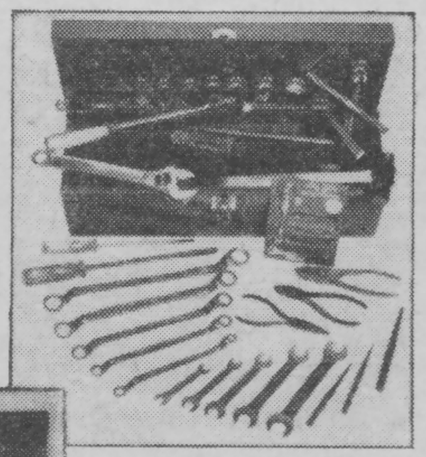
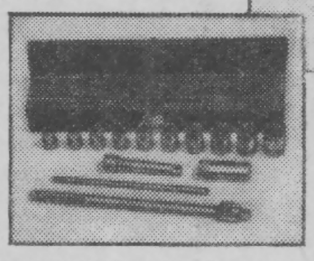
Students receive practical training that they can put to work early. Knowledge plus tools and testing instruments, which are included with instruction, make it possible for alert students to fix cars for profit. Some work on their own; others get part-time jobs in local shops. The extra cash pads your regular pay-check. It helps pay tuition, buy shop equipment.

You Get Tools and Engine Tune-Up Kit— You Learn by Practicing

As part of your training—and at no extra charge—you get an engine Tune-Up Kit (left). It includes a Compression Tester; Vacuum Gauge & Fuel Pump Tester; Ignition Timing Light; and portable steel case. Mechanics use these accurate, quality instruments to locate engine troubles.





You also get a set of mechanic's tools, including socket set (right). You'll be proud to own and use these fine tools. They let you learn the best way of all —by *practicing.* You get *experience* as you train. You acquire skill and speed.

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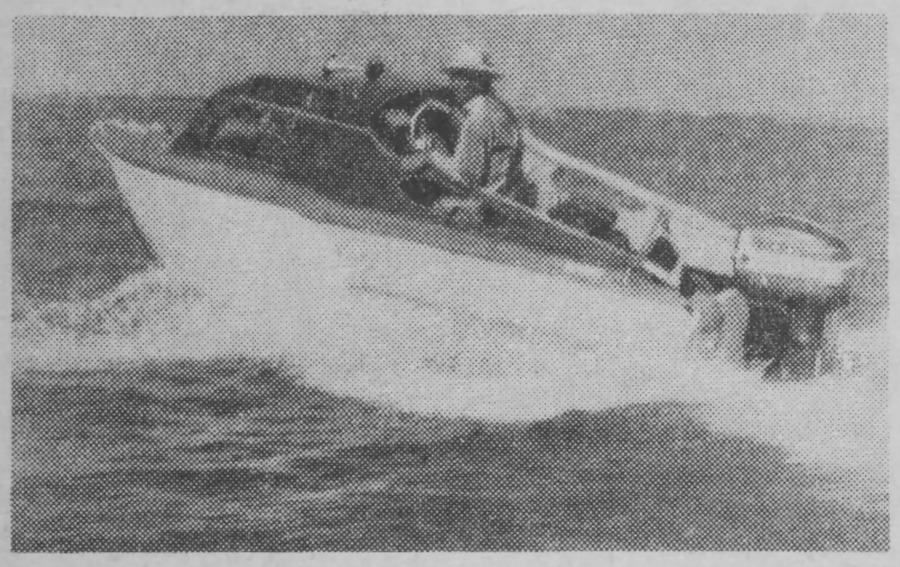
has made quite a splash here. (I am building two more for friends of mine and could have built a dozen). With a 35 Evinrude, *Sea Babe* will give me 27 *mph,* with two people, icebox, fishing gear, and all the other stuff that always goes along. She rides the chop of Baffin Bay as if she were built for it, better than a



lot of boats half again her size. Have never been able to check the speed empty—too many people want to go fishing.

Perhaps, after all this, you might allow me to make a beef about the craft prints. There are not enough dimensions given, particularly as regards frame drawings. . . . Would like to put in my request for a good "Cat" design in the 16-foot class, a cabin cruiser type that does not take high horsepower to get it on the plane.

525 E. Lott — LEWIS MCNUTT
Kingsville, Texas

Bill Jackson has a green light on developing such a catamaran, but it will take a little time for him to build it. We are, by the way, adding dimensions and more detail to our craft prints all the time, but there is a limit—short of publishing a complete book on each boat. And the beginners seem to be doing a fine job with the dimensioning they now get.

Quick Clocks

In reference to *Science Briefs* (page 34, Oct. '59 S&M) you discussed the lengthening of the day due to the slowing of the earth's rotation. I submit that a clock set 2,000 years ago would only be about 7⅓ seconds fast, and for a clock to be 2 hours fast would require about 200,000 years.

10 Lanaghan Drive — ROBERT J. MILLER
Belleville, Ill.

Like compound interest, the .00001-second gain per day is cumulative, Bob. The best way to compute the total gain is to take the mean of .02 (that's .01) and multiply it by 365 days in the year, by the 2,000 years. Thus the total accumulation would be 7,300 seconds, or just over 2 hours.

50-Mile Rockets Not Required

I think your article containing the report on the 1959 National Science Fair was about as well done as possible under the circumstances. In any future issue which you may devote to Science Fairs, you should, relatively, soft-pedal the achievements of the top winners, on two grounds: first, so many of the projects unmentioned were really as worthy as the winners; secondly, such a report as the present one is likely to discourage some students from participating. . . . While the winners do deserve recognition, it should be made clearer that one does not have to fly rockets to an altitude of 50 miles to be recognized as a potential scientist.

But again, congratulations on a good treatment in general.

HARLAN J. SMITH
Yale University Observatory
New Haven, Conn.

Your sound counsel as a National Science Fair judge is most appreciated.

Mom and Dad Friend

This wonderful project should be repeated for those who didn't get to see it the first time. It was listed as the *3-in-1 TV CONTROL* (Oct. '51, S&M).

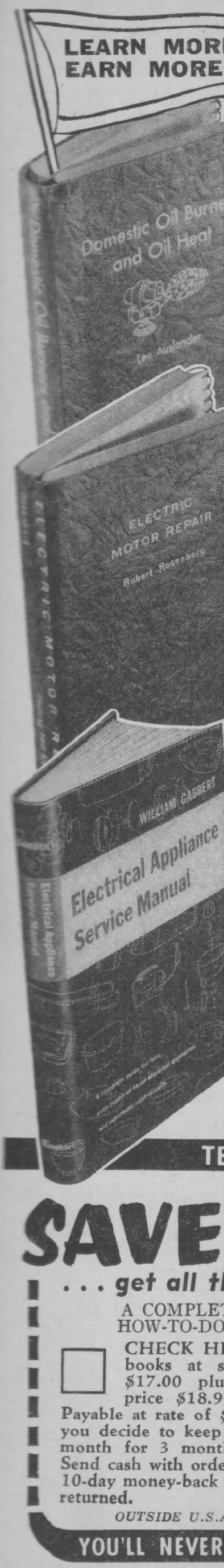
At our house it gets used mainly as a silencer for programs that Mom and Dad don't want to watch. It also works real fine for

teenagers like me who like to listen to radio in bed without disturbing others. The project was built in a cuff-link box for $1.25.

Right now I'm working on the *Transistorized Tone Generator* (Feb. '59 S&M). Will let you know how it turned out when finished.

831 Wisner Drive — ROGER PECH
Waterloo, Iowa

Do that, Roger, and send us a photo of it in operation.



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ger, and send us a photo of it in

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CITY_____ Zone____ STATE_____

Playboy Builder

I hope you will do a cockpit report on the *Stitts Playboy*. I am constructing one now and would like to know what to expect.

North Ocean Ave. WALTER A. SAMORSKI
Center Moriches, L. I., N. Y.

Along with many other experimental craft, we have been hoping to find a good Playboy to evaluate and when one turns up in our area we will certainly do it.

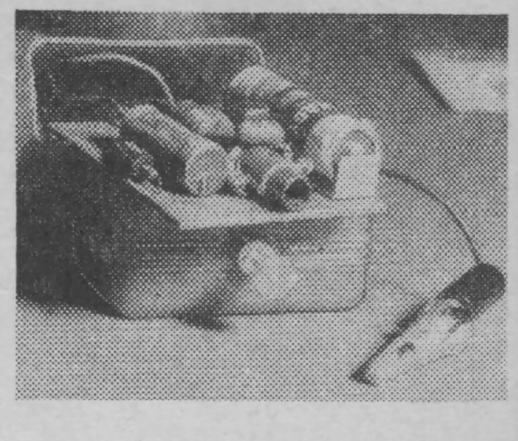
Re-covering the Stinson

In the June S&M I read your article on the *Stinson* and went out and bought one. You stated that re-covering in fiberglass is available in kit form, and I would appreciate the addresses of the supply firms.

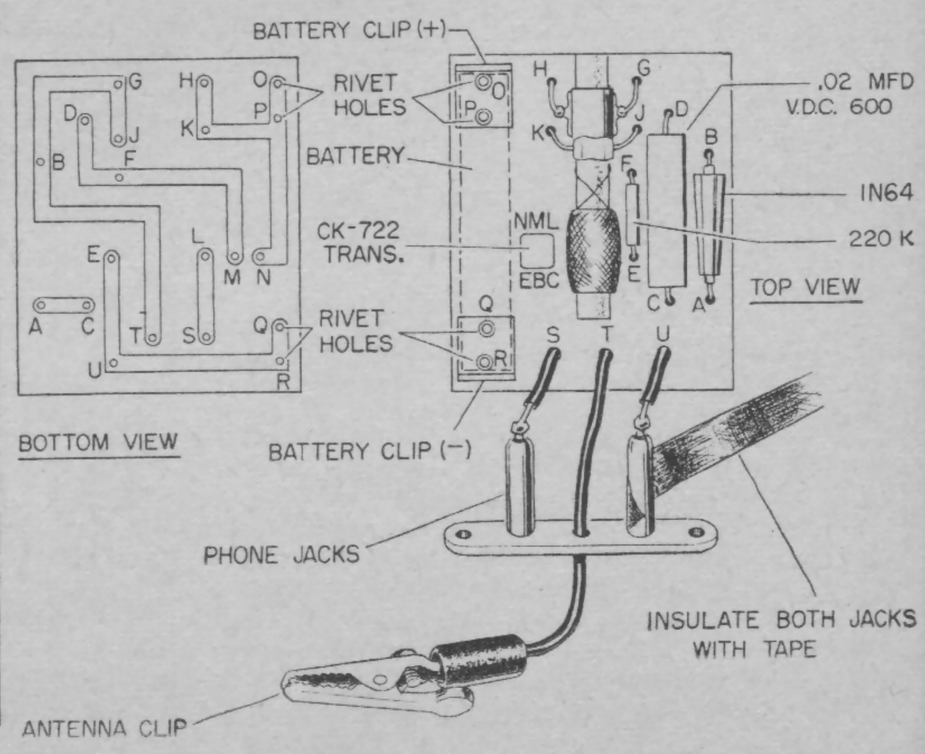
P.O. Box 5299 PAUL C. ARANHA
Nassau, Bahamas

Material and instructions can be had from: Glasco-Air, Inc., Ventura County Airport, Oxnard, Calif. Other firms also supply the material and may be just as good but this one has been recommended to us.

Etched His Circuit



I always try to build electronic devices in smaller cases than the plans specify and I couldn't find that box specified for your *Transistor Pocket Radio* (Radio-TV Experimenter, Vol. 3), anyway. So I went to the dime store and bought a cigarette case. When the radio was finished the connections kept coming loose. So I designed the connections on an etched circuit, being very careful to get the exact measurements so that the wires would line up with the small holes. After I had all the bugs ironed out and I was sure it would fit I ordered a Kepro etching



I am printing my messag
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I Have All The Money

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Please don't misunderstand
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e. WALTER A. SAMORSKI
, L. I., N. Y.

any other experimental craft,
oping to find a good Playboy
when one turns up in our area
y do it.

Stinson

S&M I read your article on
l went out and bought one.
re-covering in fiberglass is
form, and I would appreciate
the supply firms.
PAUL C. ARANHA

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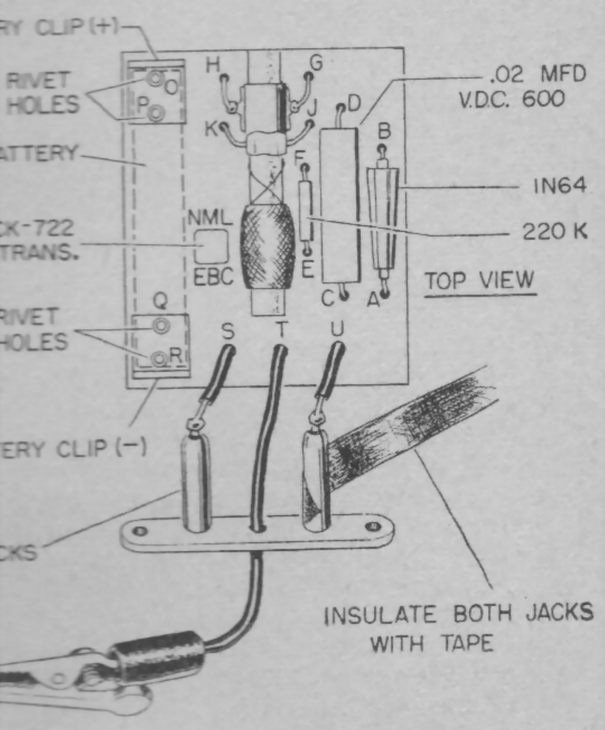
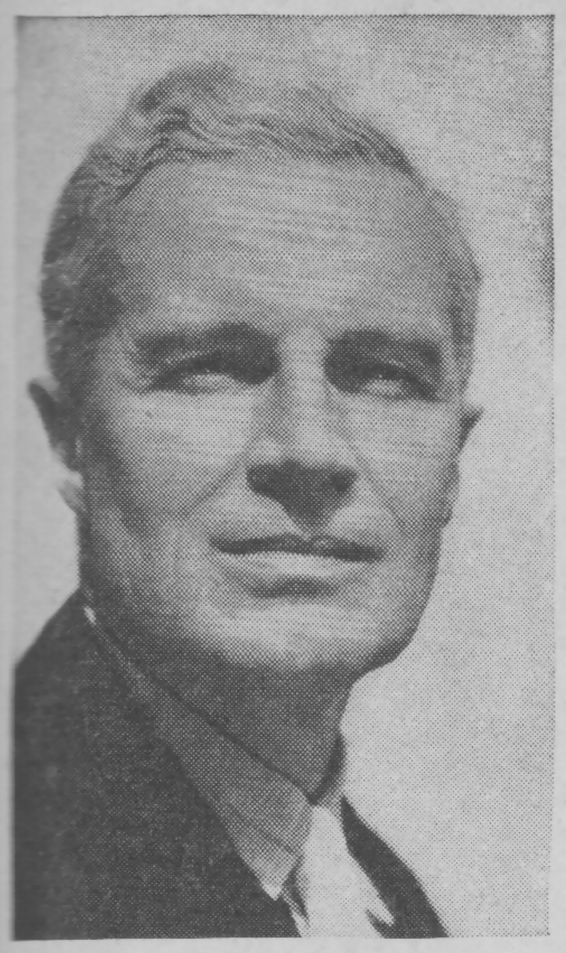


I'd like to give this to my fellow men...

while I am still able to help!

By Victor B. Mason

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my Winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.



I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things; of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life, is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows". It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own". It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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kit $3.38). I cut the board 2 x 2¼-in., painted the circuit on and then etched it out as per the enclosed drawing. I made the battery clips by bending aluminum, and put two rivets in each clip.

Although I used no ground connections, one night I picked up Cleveland, Ohio. That station call almost knocked me out of bed.

You don't have to buy the 180 mmf capacitor if you get the antenna coil with a short piece of large size insulated wire wrapped around the core because it serves as a capacitor.

I got the knob for the tuning coil by sawing off the top of the plastic handle on a small screwdriver and then I threaded the knob to fit the shaft.

℅ Mr. E. A. Hines
WTVD Television
Durham, N. C.

STEPHEN P. HINES

You did a grand job in redesigning the set, Steve. It strikes us that it might be a good idea for us to work up an article in etching circuits if enough Round Table members are in favor of the idea.

Japanese Moon Rockets?

Are the Japanese sending rockets to the moon? A recently returned GI from Japan said that they are.

R. D. #2
New Castle, Pa.

H. B. SUZUKI

It's news to us, Reader Suzuki. Did anyone check that GI's sake *intake?*

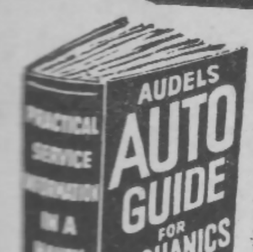
Bone-Dry Ride

This *Fire Fly* (Craft Print 55) was built with durability as the prime requisite, and speed of secondary importance. Most of our time is spent "wave-hopping" in very rough water with occasional short speed runs. Fire Fly's bow has yet to look at a transom of any

stock outboard in this area. If she were built light, say under 200 lbs., I think you would soon find a significant increase in your insurance rates.

Several internal hull strengtheners were used. The transom thickness was increased ¾-inch to 2¼ inches, and the bottom battens on the forward plane were "T"-shaped. The building form was made of oak, shaped to reduce weight, and left in the boat permanently

WHAT ALL AUTO ME... WANT TO ...



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ines STEPHEN P. HINES
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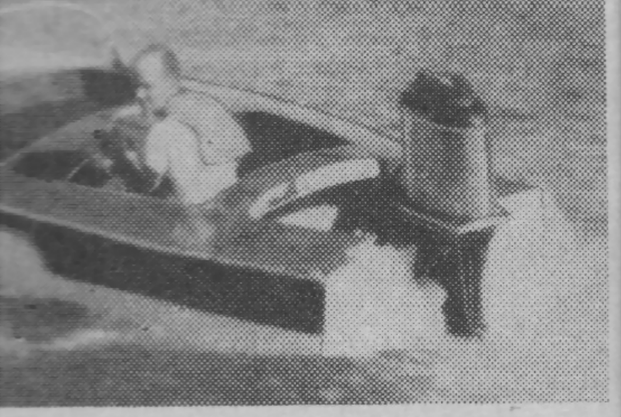

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and left in the boat permanently

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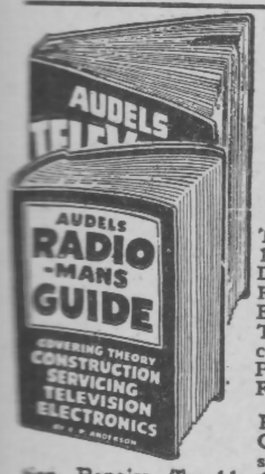

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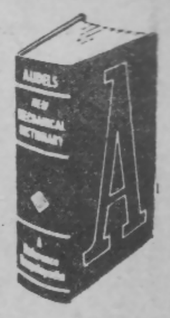

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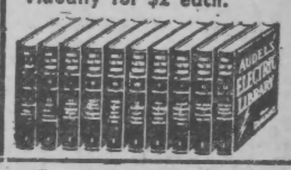

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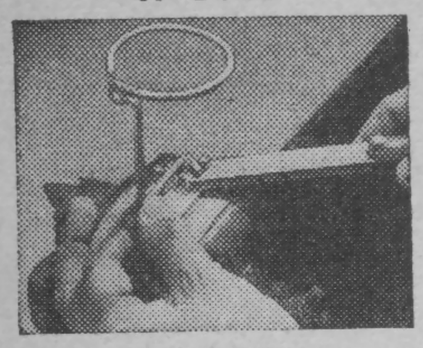

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to prevent the bottom from flexing at high speeds and to give the advantage of a single-length keel (sure hope Bill Jackson doesn't read that). The ribbon-striped Philippine mahogany decking flares back to the transom cut-out; this helps beef-up the transom and moves the passenger weight near the keelson, providing better longitudinal balance and a bone-dry ride.

She is powered by a 60 *hp* Merc with a 12 x15 wheel from a larger, 70 *hp* engine. I haven't had her on shore long enough to weigh in yet but would estimate at 400 lbs. Her speed is between 42 and 43 *mph*.

Would like to state how much boat cost, but am forced to use discretion as wife might read this letter.

820 West Park Ave. ROBERT A. PAVLICK
Joliet, Ill.

Boat Editor Bill Jackson is still muttering to himself about your leaving the building form in. Apparently it accomplishes what you want it to, and you seem willing to clip her wings a bit with that extra weight.

Test a Fury?

Your 1960 new car coverage (Dec. '59 S&M) was the best organized and most easily read I have come across.

Under Plymouth you state a 0-60 time of 6.7 seconds. What was the model and engine of this car? Will S&M test this same car and engine?

Perkasie RR 1 RAY BISHOP
Pennsylvania

That was the Fury with the big power plant, Ray, 361 cu. in. to be exact. Doubt if we will have issues and space enough to test a Fury before the new models come out, but we might catch next year's for you.

Modest Ramblers

I enjoyed particularly the *comparison of 1960 cars* (December 1959 S&M). Noticed you show cubic feet of trunk space for Rambler Americans and regular Ramblers as 8.2 and 13.5, respectively. While this agrees with American Motors' specifications, I believe this detail is not comparable to that given for other automobiles. Most certainly, the Corvair does not have more trunk space than the regular Rambler, nor are the Falcon and Valiant nearly double the regular Rambler.

340 Fifth Avenue R. I. BEGGS
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You're dead right, Reader Beggs, and we called this to the attention of American Motors' officials. But they stood by the figures shown in the AMA specifications. Actually, as we have warned readers before, such trunk dimensions are meaningless, because of the difficulties of measuring irregular luggage compartments.

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ROBERT A. PAVLICK

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Wants Tailwind Plans

In your article on the *Tailwind* you asked us not to write to Mr. Wittman, yet you say that plans for the conventional version will be still sold. Can you tell me how to get them?

2101 Serles Rd. J. E. BAMBERGER
Baltimore 22, Md.

Sorry if we didn't make it clear. Plans for the original Tailwind are available from Steve Wittman, Winnebago County Airport, Oshkosh, Wis. However, plans for the new tricycle-gear version are not yet ready and Steve has no facilities for corresponding about it until they are.

Mercedes Diesel Report

The Mercedes Diesel article (Aug. '59 S&M) was very interesting and well written. At the time, I had ordered the exact model that was tested, and I was looking for facts that would justify my purchase.

Since reading the article I have received the car and am very well pleased. I have found things to be as you reported.

The first 86 miles were driven from sea level to 3800 feet with five passengers in three hours time, with a consumption of 2.7 gallons of fuel costing 52¢ U. S. here. The next 665 miles were in the city of San Jose, where the streets are narrow and at least 70% of the driving is in not over third gear. At the second filling, with the speedometer reading approximately 275, the fuel consumption was 28 *mpg*. After the 300-mile check-up, the consumption was about 30 *mpg*.

Am keeping a record of usage and expenses and would be glad to give you further information if you would be interested.

Apartado 2367 W. G. FORMAN
San Jose, Costa Rica

We'd appreciate a report from you after your Mercedes Diesel has logged about 5000 miles—particularly if you can itemize costs.

Cheese Boxes for Children

Have been reading your magazine for several years—it is the best of its kind on the market. However, I would like to make a couple of humble suggestions.

You see, I have five children, so that does not leave much cash for me to play with your projects—I merely drool!

Three of my kids are boys, the oldest 15, and when I was their age I made things from material available—cheese boxes, apple crates, etc., at little or no cost . . . I would like to see projects in your magazine aimed at the young craftsmen in this world.

West Cornwall HUGH K. MCCAFFERTY
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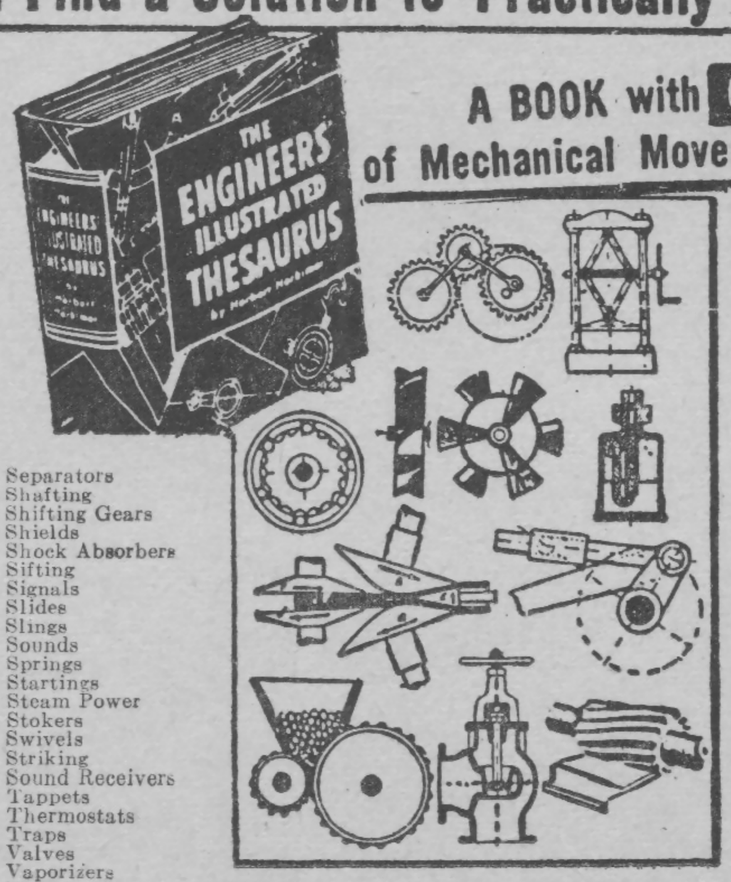

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Toss a tornado in a toolbox, and you'll have something approximating the changes going on in our office workshop recently.

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Quite an assignment, that. Come up with twice as many interesting ideas. Develop twice as many of the how-to projects you readers have requested. Double the number of behind-the-news articles in the fields of science, industry, transportation, home-building and invention. And on all of these, do our best to observe the same standard of editorial dependability we have always tried to maintain.

Perhaps that's why *Science and Mechanics* has the highest percentage of voluntary, newsstand-buying readers in its field. No editor can kid a customer who goes shopping for every issue—whose readership can't be held with a long-term subscription, and whose loyalty can't be bought with a lot of hoopla and fancy art and editorial effects.

Such a reader wants facts —exactly why something is significant, and precisely how it works. He wants to know where he can get it, what it will cost and whether it will really save money. He expects to be told, frankly, when it will be perfected to the point where it will benefit him.

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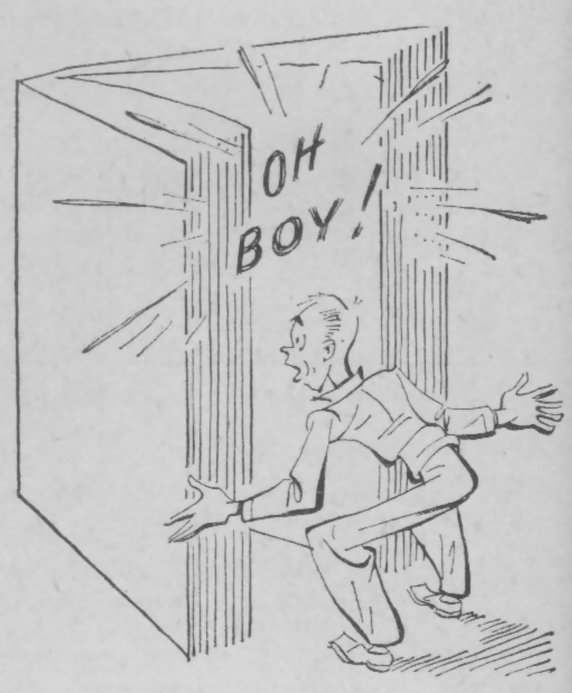
True Confession

There have been times in the past, we must confess, when we tried to pack so many facts into the relatively small space which used to be allotted us for articles, that our type and illustrations became, shall we say, a bit small for easy reading. From now on, you won't need to reach for bifocals in order to build that boat, or a magnifying glass to decipher that circuit diagram. Both the type and illustrations will be larger. And there will be more color used, where it helps to make the story interesting and easier to comprehend.

In fact, if you have an old S&M handy, lay it down alongside this issue. The difference in appearance may surprise you.

More Editorial Content

The big change, of course, is in the greater number of *editorial* pages we can now use. It shows up in our being able to give you twice as many of the popular *Shop Kinks* and *Ideas for Your Home* in this issue. It makes it possible to restore the *Modelcraft* and *Electricity* departments, two "old friends" many of you will welcome back. It also means we can now bring you—within the magazine and not as separate, extra-cost craft prints—the timely chord



organ and tape recorder how-to's you'll find added between the pages of this issue.

There'll be more such special bonus features. Some will be blueprints, some will be fold-out features in full color on subjects you have asked us to cover. Watch for them in future issues.

Or better still, write me, outlining your ideas on the features and projects you feel will make S&M the most useful and interesting magazine you have ever read.

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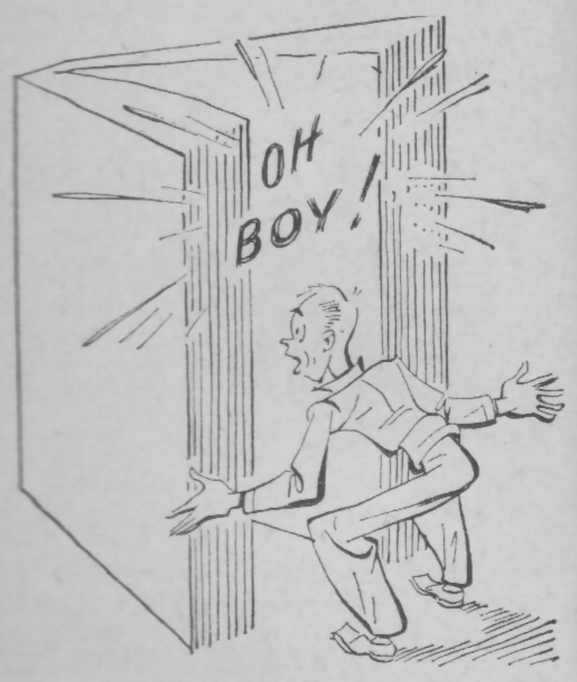

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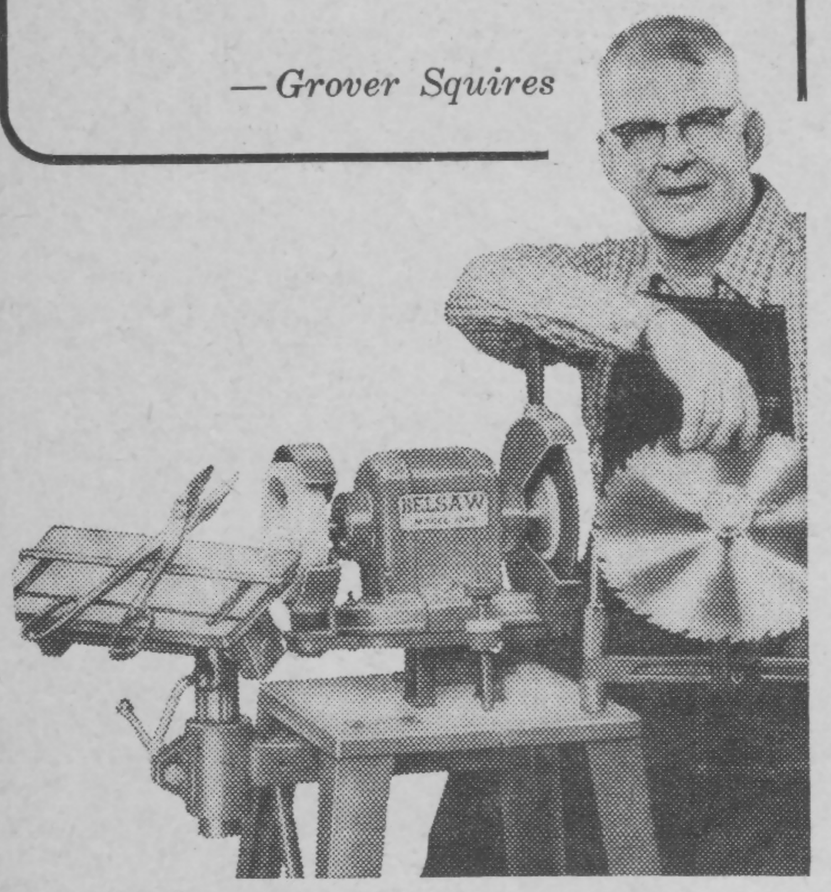

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• The *Homeowner's Guide to Humidification* is a non-technical discussion of what humidity is, why indoor air becomes dry in winter, what humidity does to you and your home, how to put an end to dry air problems and how much humidity your home can stand. To obtain a copy of this 15-page booklet, write the Armstrong Machine Works, Dept. RTG, Three Rivers, Mich.

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• $2 sent to the Arco Publishing Co., Dept. SM, 480 Lexington Ave., New York, will bring you a copy of *Handbook for Skin Divers.* Included in the 142-page hard-bound book are discussions of the equipment and technique of skin diving, submarine life and skin diving in various areas of the U. S., underwater vehicles and photography.

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• *How to Refashion Your Furniture* is described in a 15-page booklet available from The William-Frederick Press, Dept. 333, 391 East 149th St., New York 55, N. Y. Two pages of suggested transformations plus some tips on using foam rubber and repairing and reupholstering furniture are contained in the book.

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—o—

• An aid to tracking those satellites has been prepared by Research Publications, Inc., 1687 Laurel, San Carlos, Calif. In full color, the *Satellite Tracker* has an array of charts, graphs and scales that will show the height, direction and angle a satellite will go over your home. Priced at $2, the tracker comes with a booklet describing how the Atlas and Discoverer were tracked.

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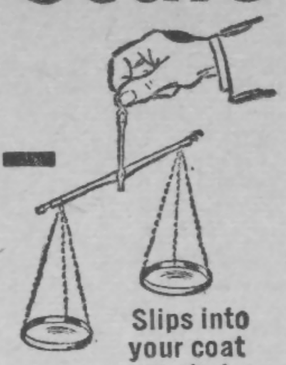

Slips into your coat pocket

In almost every home there are certain pieces of broken or discarded jewelry—old rings, lockets, watches, spectacle frames, even old dental bridgework and crowns—that housewives consider worthless. Yet the fine gold in these "worthless" articles is worth $35.00 an ounce to the U.S. Mint, ***and they'll buy all you can get!*** I show you where to find this "junk" jewelry, how to test it, how to weigh it on the little pocket scales I furnish, and tell how much to pay for it. Then I tell you how to send this "junk" to the U.S. Mint who will pay you $35.00 an ounce for all the fine gold in it—less a small charge for handling and processing. If you follow my simple instructions for testing and weighing, in a few days you should get a U.S. Government check for ***at least twice*** what you paid for the "worthless" material. You ***double your money!*** I'll also tell you how to get groups of people to collect discarded jewelry for you in large quantities. If you would like to know all about this fascinating way to make money—***without selling***—just send your name to me on a postcard and I'll send complete information, free, telling exactly how you can get started on a "gold hunt" of your own.

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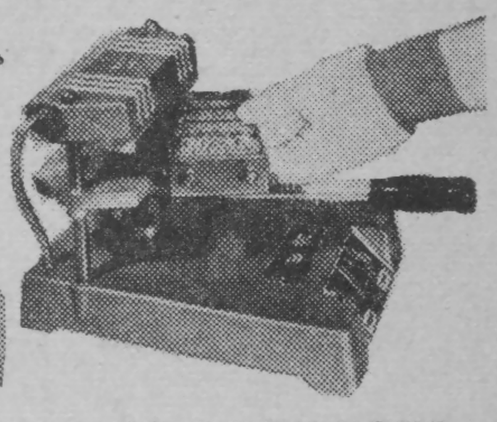

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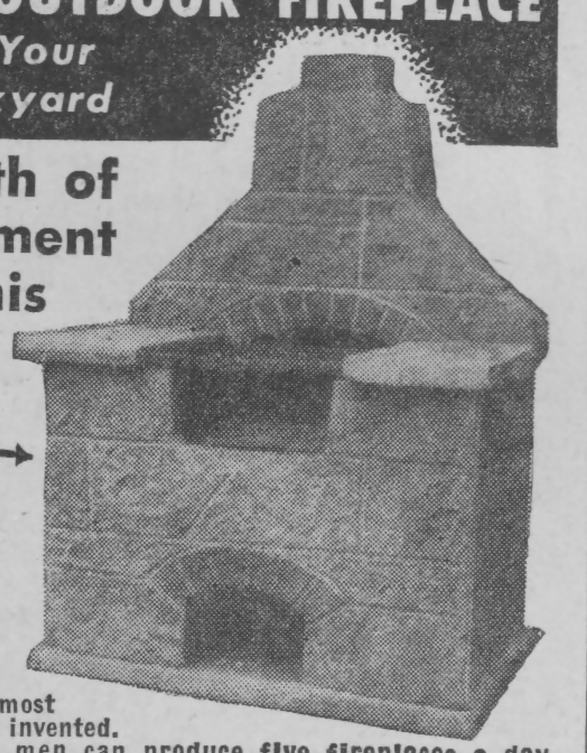

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• Among the 40 different construction projects in the Spring, 1960, edition of the *Radio-TV Experimenter* are a six-meter converter, a miniature multimeter, a telephone-actuated remote control switch, a radio-tv sound dimmer, and a three-transistor portable. For SWL-ers there is a 10/20 receiver and articles on what to listen for and when. For would-be hams there's an article telling how to memorize Morse in 20 minutes. And for one and all there's a run-down on yesterday's (1934's) radio programs, plus the latest revision of *White's Radio Log.* Get your copy of the *Radio-TV Experimenter* (No. 565) at your local newsstand, or send 75¢ for it to Science and Mechanics, 450 East Ohio St., Chicago 11, Illinois.

—o—

• 25¢ will bring you a copy of the 11-page booklet *Basement Pre-Planning,* which gives some unusual ideas on basement planning for homes to be built or remodeled. Such items as planned traffic patterns, better light and ventilation and the possibility of a greenhouse are considered. Booklet is obtainable from the Williams Oil-O-Matic Heating Co., Dept. RAA, Columbus 8, Ohio.

—o—

• For free you can obtain a 14-page booklet which describes magnifiers and readers and how to use them. Called Readers and Magnifiers, the booklet was prepared by Bausch & Lomb, Dept. DT, Rochester 2, New York.

—o—

• The American Medical Assn. has made available to our readers a limited number of leaflets entitled *Recommendations of Committee on Toxicology on First-Aid Measures for Poisoning.* Obtain a copy from the Assn. at 535-SM No. Dearborn St., Chicago 10, Illinois.

—o—

• How to apply redwood siding is the subject of a 4-page illustrated information sheet available free from the California Redwood Assn., Dept. Homeowners Service Library 101, 576 Sacramento St., San Francisco 11, Calif. Called *Redwood Siding: Application Sheet 3A4-1,* sheet outlines proper handling and preparation of siding, construction tips, the use of caulking and flashing and how to reduce moisture condensation.

—o—

• Foreign car enthusiasts can now obtain tune-up charts, at $3 a set of 36, for each make and model of the following cars: Austin, Austin-Healy, Borgward, BMW, Citröen, DKW, English Ford, Fiat, Hillman, Jaguar, Lloyd, Mercedes-Benz, Metropolitan, MG, Morris, NSU, Opel, Peugeot, Porsche, Renault, Simca, Sunbeam, Taunus, Vauxhall, Volkswagen and Volvo. Obtain from the Automotive Electric Assn., 16223 — HMG Meyers, Detroit 35, Mich.

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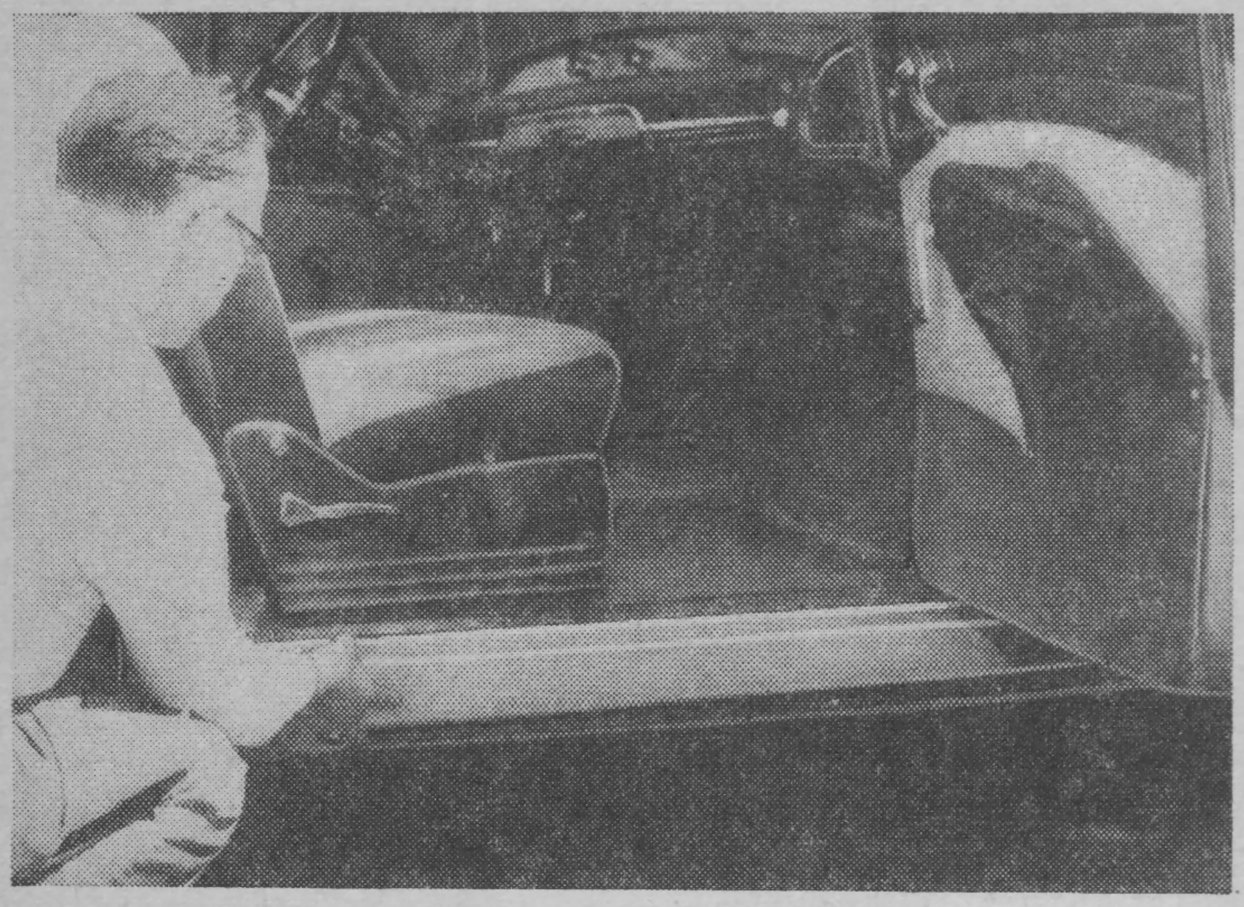

Fitting the new panel over the rusted one.

Rocker Panel Repair Kit

• The rocker panel repair kit enables the car owner to renew damaged rocker panels below car doors without special tools or skills. Kit includes rocker panels for both right and left sides, all necessary fastening materials and instructions. Made of steel and die-formed for a custom fit, panels do not require metal conditioners or primers, but may be painted or lacquered. Panels are fitted over the originals without cutting, burning or welding. Installation takes about half an hour, according to the manufacturer, Richline Co., Inc., Dept. SAA, 1531 E. Franklin Ave., Minneapolis 4, Minn. Panels for 2-door models are $7.95, 4-door models, $9.95. User must specify the make, model and year of his car.

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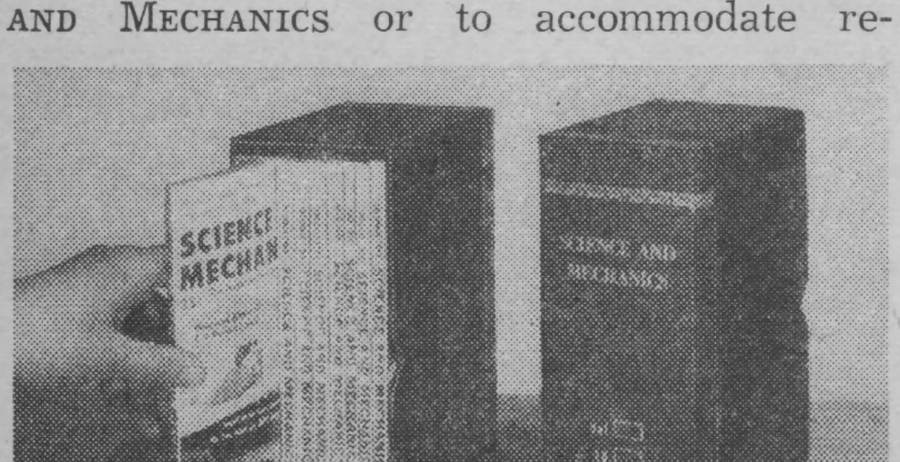
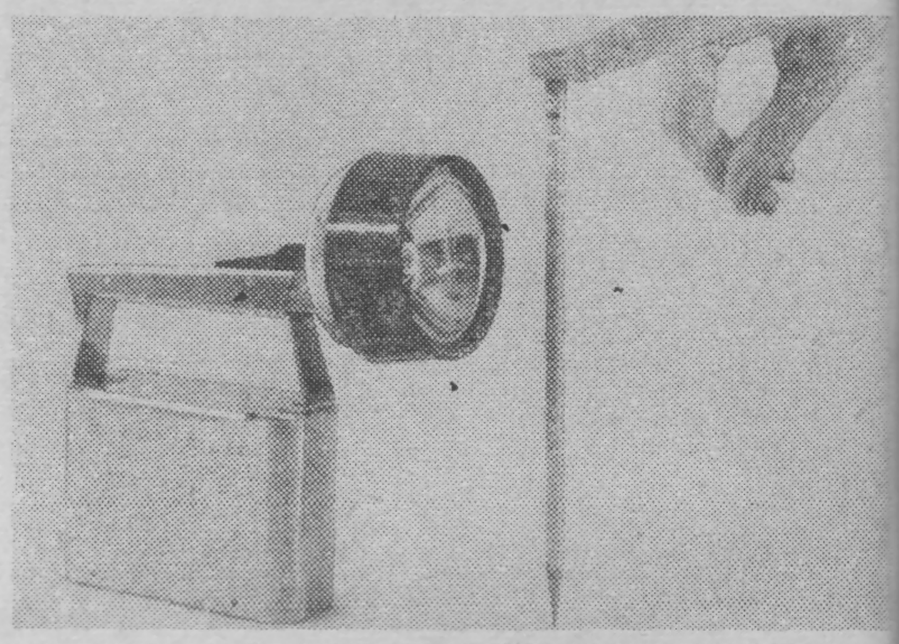
• New file boxes are custom sized to fit any of the popular magazines such as SCIENCE AND MECHANICS or to accommodate reports and papers. Magazine Files are imprinted in gold leaf with the name of the magazine and the year it was published as specified by the purchaser. Goldfoil is also furnished for marking volume or issues in files. Files for reports in lieu of imprinting are furnished with reference card holder in which typed description of contents can be inserted.

In ordering files for materials other than magazines, height, depth and width (maximum width, 5 in.) should be given. Files are available for $2.50 each from Edmund Scientific Co., Dept. WSC, Barrington, N. J.





Small Flashlight-Lantern

• Hands-free operation, powerful beam and small size are the main characteristics of the *Radar-Mate* intermediate-size lantern. Powered by three standard flashlight batteries, its lighthead is movable within a 135° arc. Made of chrome-plated steel trimmed in brown polystyrene. The Radar-Mate is made by Burgess and is available in hardware and other consumer stores for about $5.

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• Now vinyl wall-covering sections that resemble brick or stone are available prepasted. Application consists of removing the protective paper and applying the panels to any clean, dry surface. Surface smudges are easily removed with household soap or detergent. Should a change in color be desired at any time, the material can be painted with

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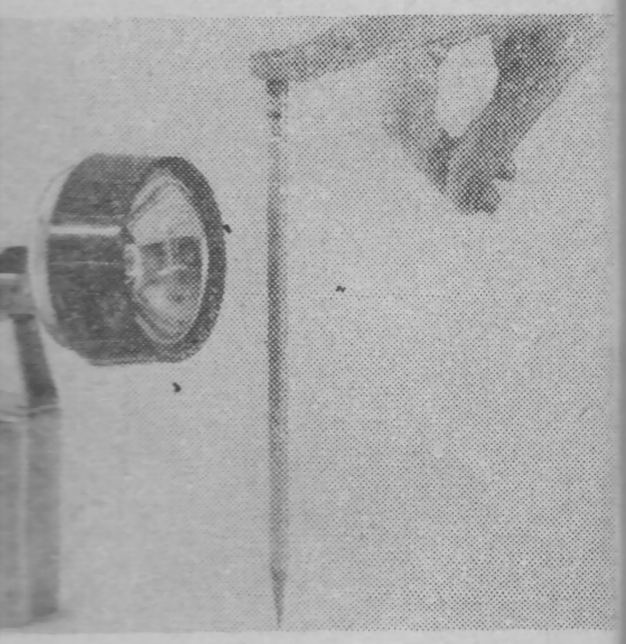

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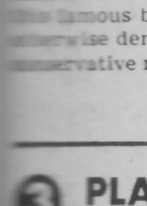

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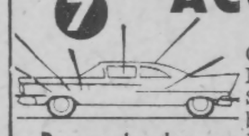

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MORE WIDELY USED IN SERVICE SHOPS THAN ANY MANUAL OF ITS TYPE!

JUST LOOK UP THE JOB YOU WANT TO DO!

Chilton's AUTO REPAIR MANUAL (30th annual edition) is a complete troubleshooting and step-by-step service guide to every model of the leading 22 U. S. car makes for 10 years past! 3000 clear illustrations explain jobs so clearly it's next to impossible to go wrong. Has 1024 big pages. Weighs almost 5 lbs. Ideal for beginners. Invaluable for experienced mechanics who want fast, accurate answers to puzzling problems. Shows how to do jobs with **standard tools**—from tune-ups to transmissions—from power steering to ignitions and all the rest. The world's most famous car manual! Contains up-to-the-minute methods and equipment data—not just a re-hash of old material or car mfr's. manuals. Price $7.95.

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A practical book for men who want to force ahead in maintenance work! A guide book of proven methods and ideas for lighting; wiring; tools; controls; power transmissions; hoists; conveyors; power trucks; roofs & floors; valves; compressors; heating; air conditioning; lubrication, etc. Price $5.50.

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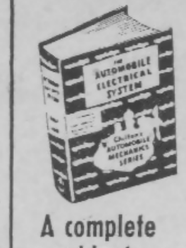
⑮ Troubleshoot & Repair AUTO ELECTRICAL SYSTEMS



A complete guide to fast, accurate car electrical service

Electrical failures are one of the chief causes of car troubles. Chilton's new AUTOMOBILE ELECTRICAL SYSTEM manual teaches you to handle all of them! Includes: Circuits; Batteries; Lights; Ignition; Accessories; Generators; Regulators; Starting Motors, etc. A down-to-earth **professional** guide that helps you locate troubles fast and fix them **right!** Over 300 illustrations. Price $7.95.

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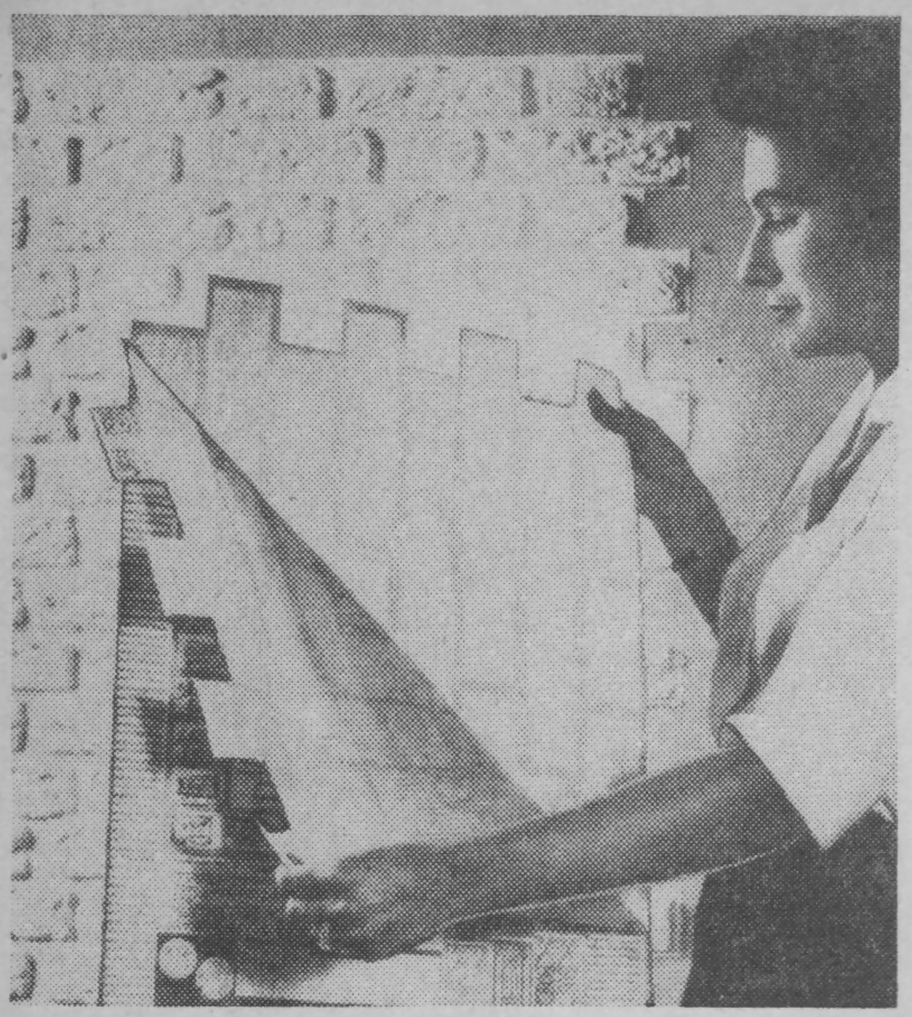
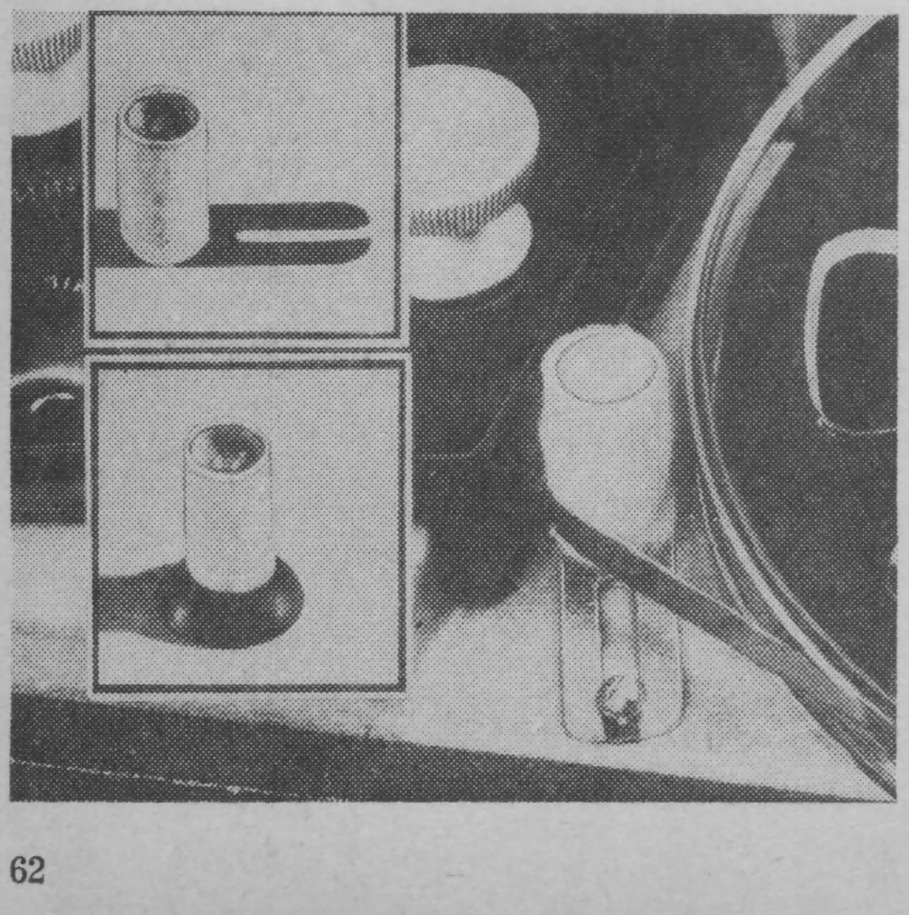


latex base and vinyl-paints.

Prices for the four sq. ft. panels range from $1.39 to $2.79 according to the pattern (there are seven in various colors). The manufacturer, the Decro-Wall Corp., Dept. HMG, 21 Saw Mill River Road, Yonkers, New York, tells us they may be obtained from wallpaper dealers.

Film and Tape Cleaner

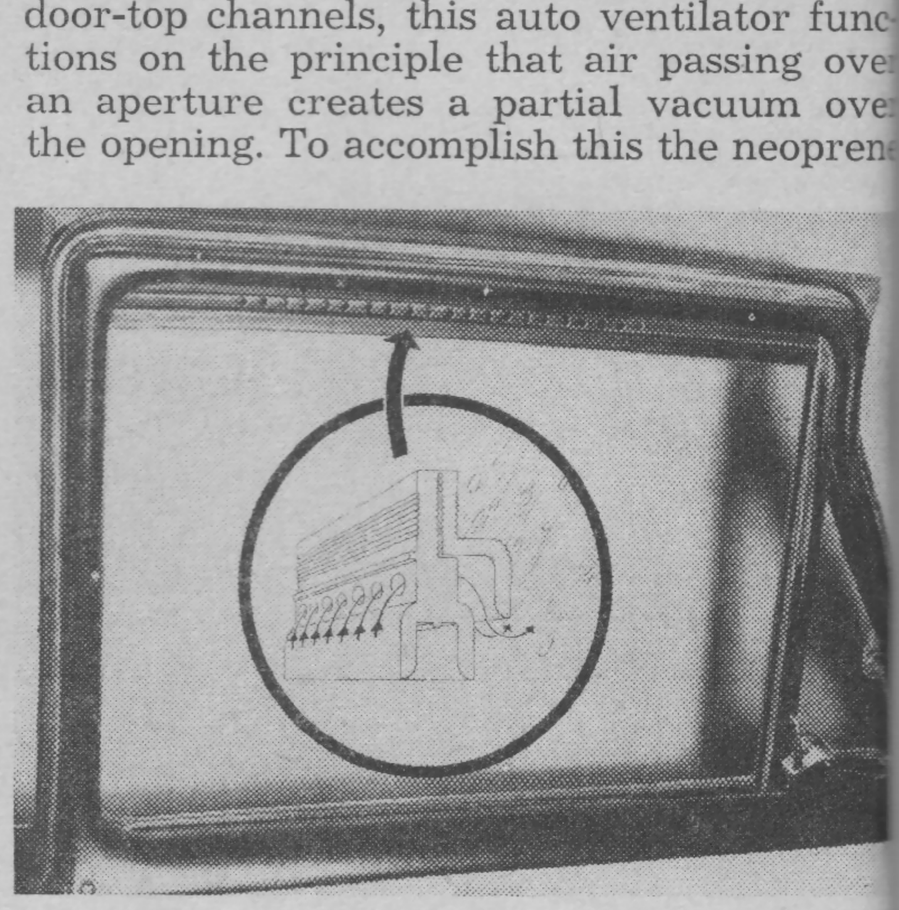
• The *FilMagic Pylon* cleans and protects movie film and recorder tapes by applying a coating of fluid silicones to the moving surfaces while the reproducing equipment is operating. Pylon contains a reservoir of fluid silicones from which lubricant is filtered through a removable sleeve onto the tape or film as it passes. Silicone coating sets up an invisible barrier against heat and abrasion, and the moving surface is used as a carrier into parts of the equipment to lubricate them.



Kits for tape recorders (containing a choice of flange-type or suction-cup pylon) are $2.95 each, while the kit for 16mm Ampro, Bell & Howell or Eastman movie projectors are priced at $5.40 and those for RCA, Victor or TSI projectors cost $6.25. Kits are made by The Distributor's Group, Inc., 204-M Fourteenth St., N.W., Atlanta 13, Ga.

No-Draft Auto Ventilator

• Fitting all cars whose windows are essentially rectangular and raise parallel to the door-top channels, this auto ventilator functions on the principle that air passing over an aperture creates a partial vacuum over the opening. To accomplish this the neoprene

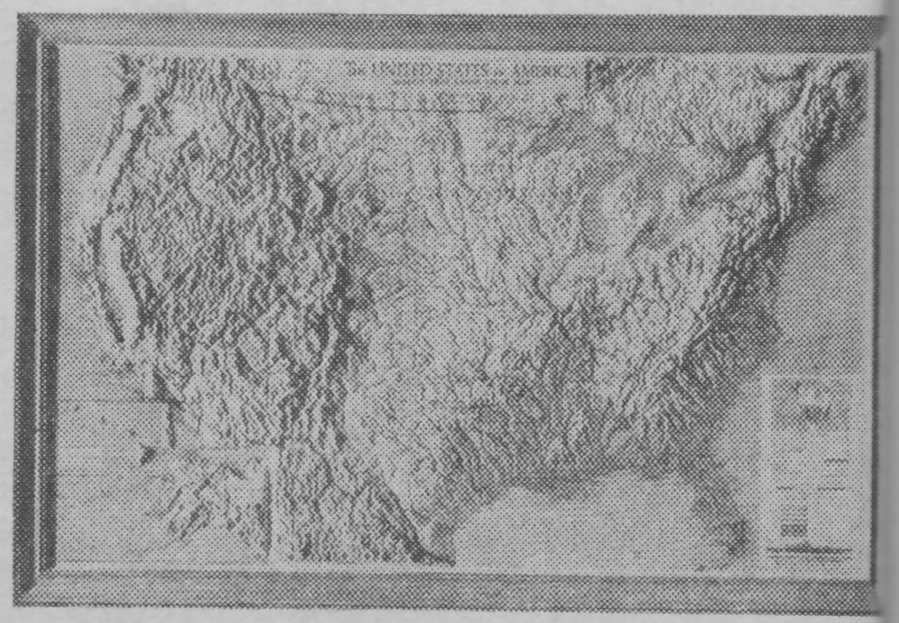


vent strip is perforated with a series of ¼-in. holes.

With all windows closed, the manufacturer says there will still be sufficient ventilation to keep the windows from steaming and frosting. Vent is also said to draw out smoke and provide no-draft distribution of air from the heater inlet. The manufacturer, Mathews Ventilator Co., Box 3001-HCF, Youngstown, Ohio, has priced the vents at $5.75 a pair.

Low-Cost 3-Dimensional Maps

• News maps of the world and of the United States show mountains and valleys in detailed relief that stands up nearly a half inch



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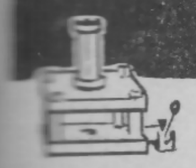

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At last a heavy duty hydraulic press 3-4 ton capacity at the amazingly low price of $850.00 complete. This press is designed for continuous operation and is precision built with high quality electrical and hydraulic components. The press bed is 16x12 in. and features a 10 in. stroke with 120 in./min. ram speed. Send for Bulletin 16126.

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Draw the Vintage C this (bigger or smaller, b Use pencil. Contest priz course—free training in Winner is taught, indivi professional artists on th largest home study art s Entries for April 1960 co must be received by Apr None returned. Amateur only. Our students not eligible. Winner notified. Mail your drawing of th Vintage Car today.

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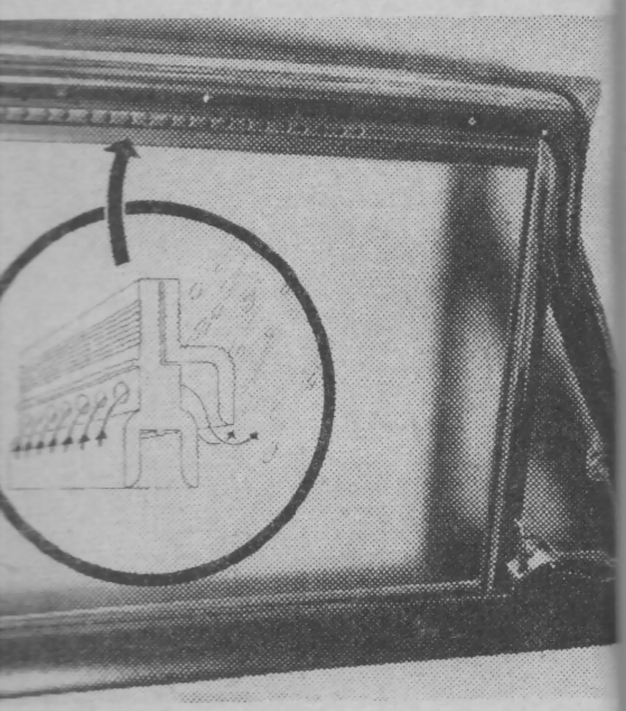
creates a partial vacuum over
To accomplish this the neoprene



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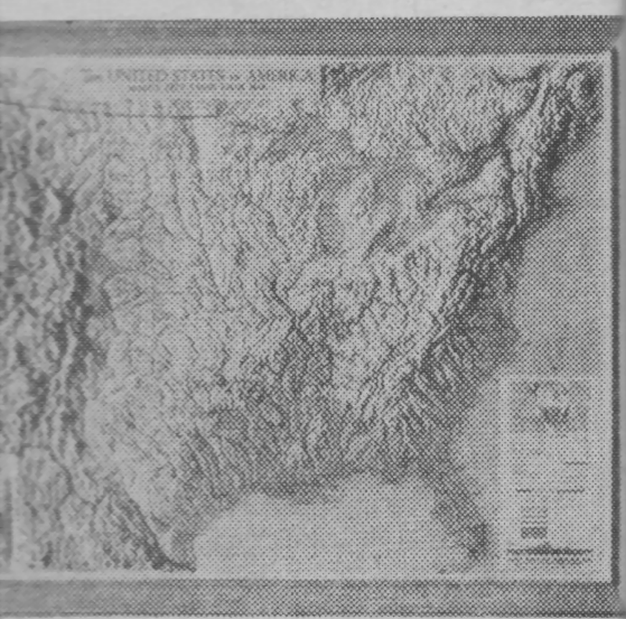

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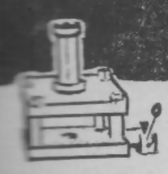

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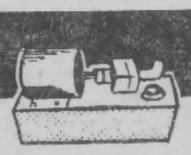

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At last a heavy duty hydraulic press of 3-4 ton capacity at the amazingly low price of $850.00 complete. This press is designed for continuous operation and is precision built with high quality electrical and hydraulic components. The press bed is 16x12 in. and features a 10 in. stroke with 120 in./min. ram speed. Send for Bulletin 16126.

Hydraulic power units that will save you money. Build your own press, modernize your old machinery, open garage doors, lift heavy loads, etc. These are heavy-duty units precision built of quality components. Prices start at $126.50 for 3/4 GPM 1500 PSI unit. Bulletin 859.

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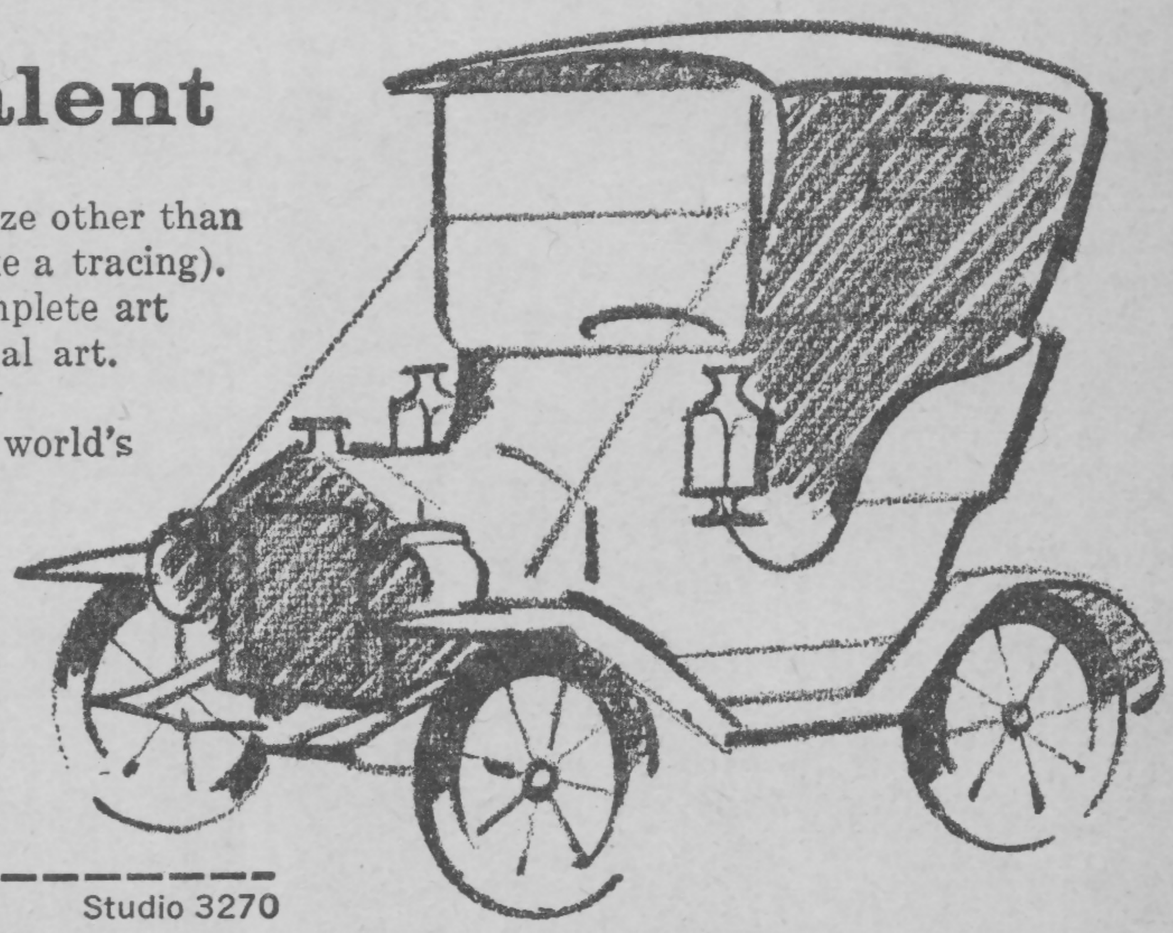
Draw the Vintage Car any size other than this (bigger or smaller, but not like a tracing). Use pencil. Contest prize is a complete art course—free training in commercial art. Winner is taught, individually, by professional artists on the staff of world's largest home study art school. Entries for April 1960 contest must be received by April 30. None returned. Amateurs only. Our students not eligible. Winner notified. Mail your drawing of this Vintage Car today.



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The world map features 2500 names and all of these names appear on the map index. Scale 962 miles per inch. Both maps have mahogany colored plastic frames and are priced at $9.95 each. Mfd. by Aero Service Corp., Dept. RS, 210 East Courtland St., Philadelphia 20, Penna.

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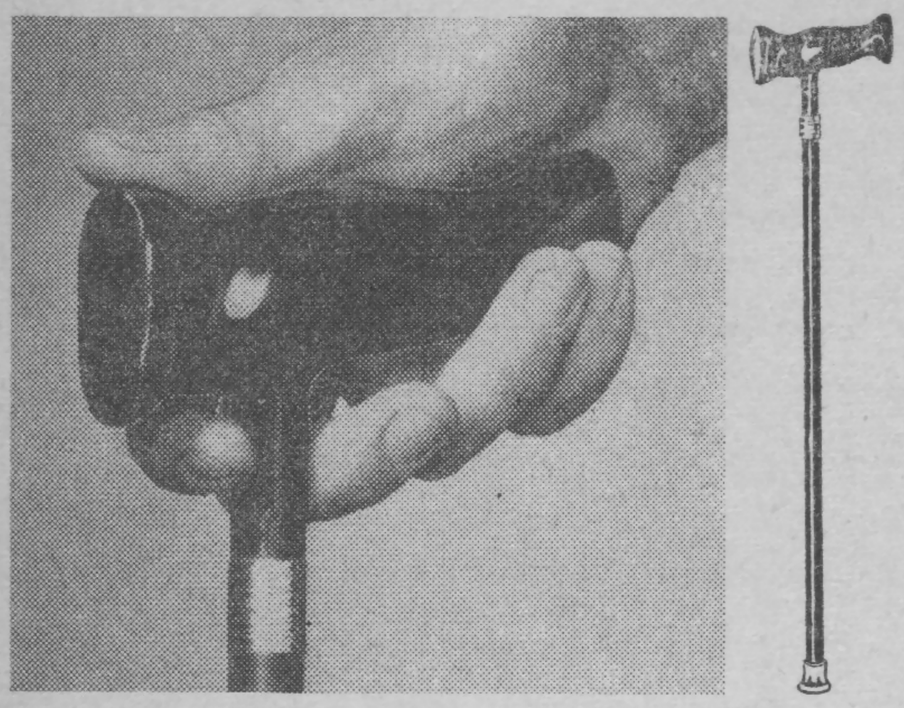
• Those having difficulty in walking will have more than average support from the J-Line canes as the handle has been shaped to the hand, the hand need not re-shape to

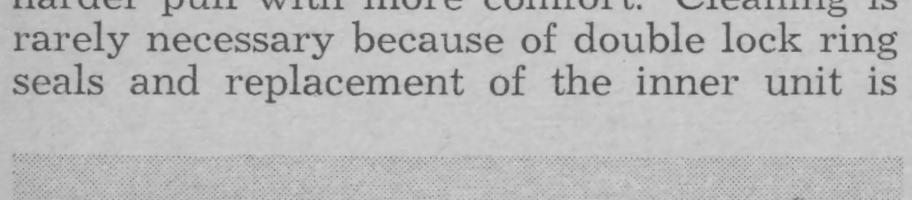


fit the cane. Because of the grip design, greater hand relaxation during weight bearing is said to ease the lot of one with arthritic finger joints.

The aluminum alloy shaft is black. Priced at $7.95, the cane is made by J-Line Products, Dept. TYG, 9036—13th Ave., S., Minneapolis 20, Mass.

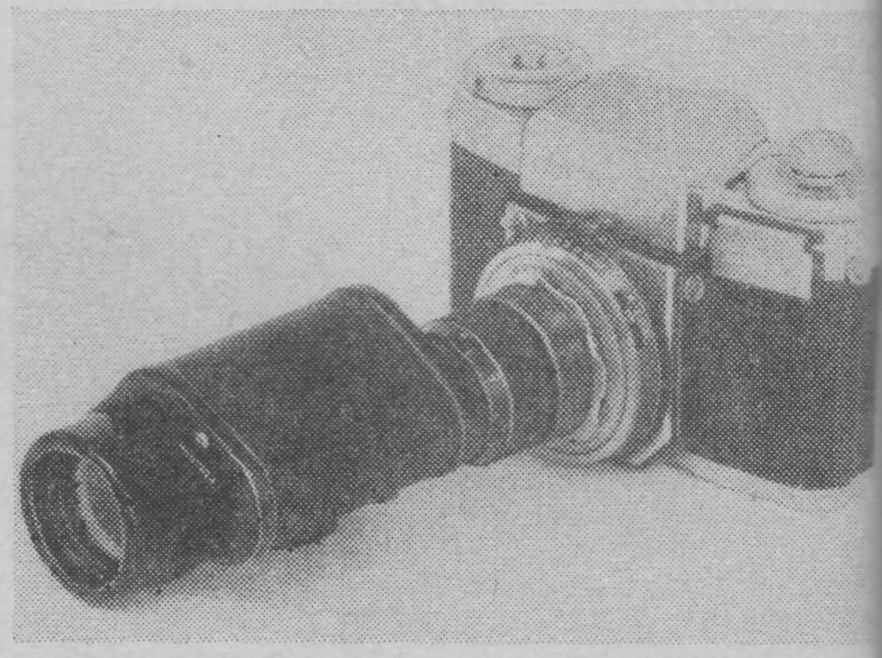
Ratchet for Tight Places

• The *Wright 500* ratchets require a handle swing of only ¾ in. at the grip, permitting the ratchet to work in tight places. Slip-proof, oil-proof rubber grips are said to permit harder pull with more comfort. Cleaning is rarely necessary because of double lock ring seals and replacement of the inner unit is simple. Available now are two ratchets ½-in. drive and ⅜-in. drive. Others will be added to the line later. Made by the Wright Tool and Forge Co., 42 E. State St., Barberton, Ohio.



Monocular Fits Cameras

• Increased focal length is available to reflex cameras with single lens or twin lens with the aid of the Spiratone monocular. Monocular which ordinarily serves its normal purpose has a removable eyepiece for which converters are available making possible the use of standard Series V ($3.95) and VI ($4.95)



filterholders available for most cameras. The Spiratones are available in three focal lengths: 6x30 ($9.95), 7x35 ($12.95) and 8x30 ($13.95). Each is equipped with a tripod socket, pigskin carrying case and strap. Distributed by Spiratone, Inc., Dept. SFS, 135-06 Northern Blvd., Flushing 54, N. Y.

Illuminated Oil Pressure-Ammeter Gage Kit

• Tired of the idiot lights on the family bus? This new kit features an 80-lb. oil pressure gage and a 60-0-60 ammeter mounted on an illuminated chromed panel. Complete with a 6 and 12-volt bulb, bulb socket and lead wire, copper tubing, brass fittings and illus

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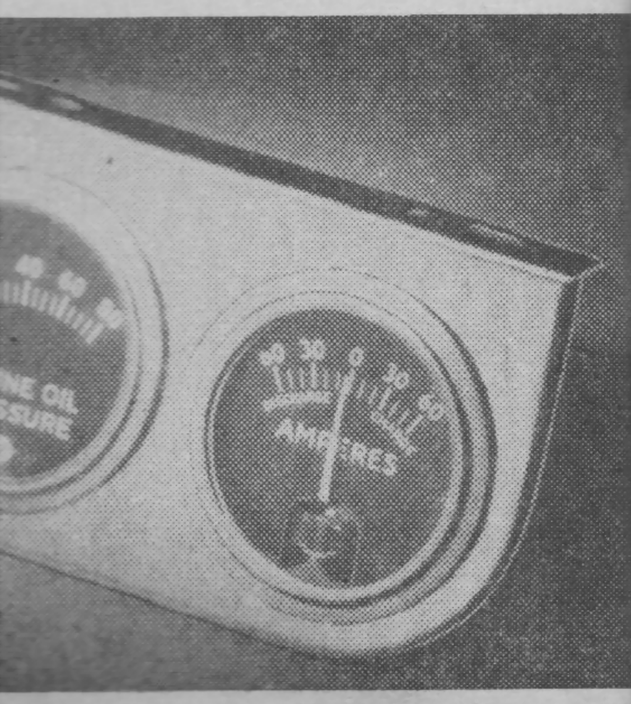

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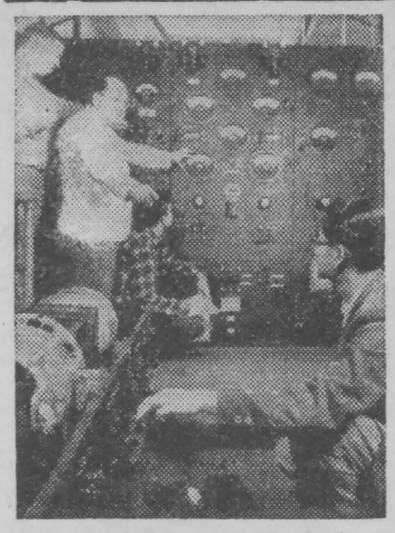

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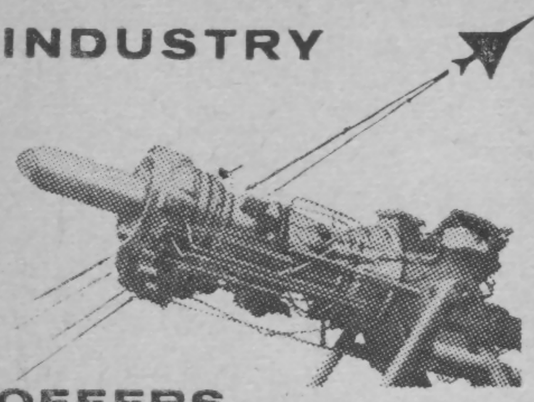

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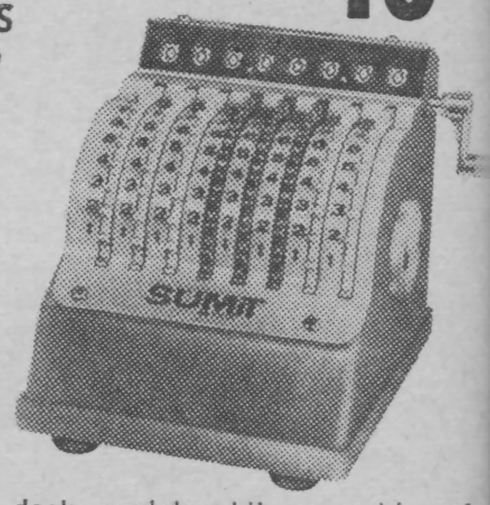

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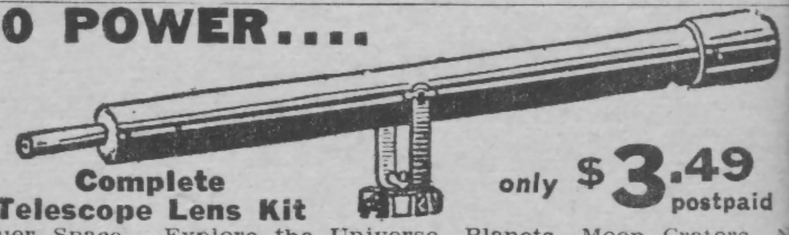

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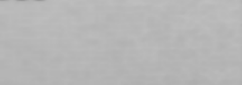

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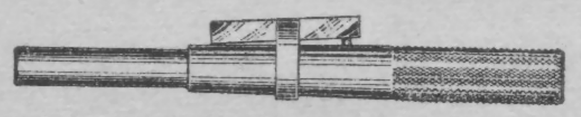

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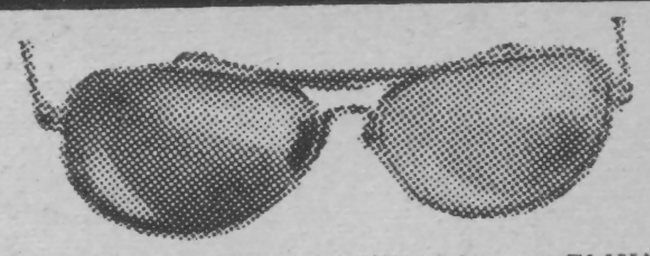

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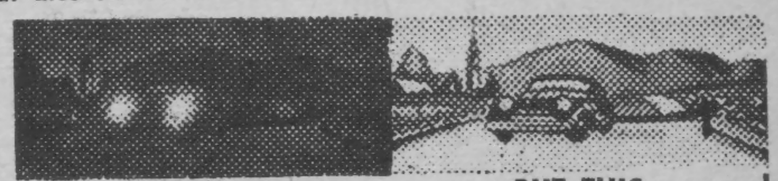

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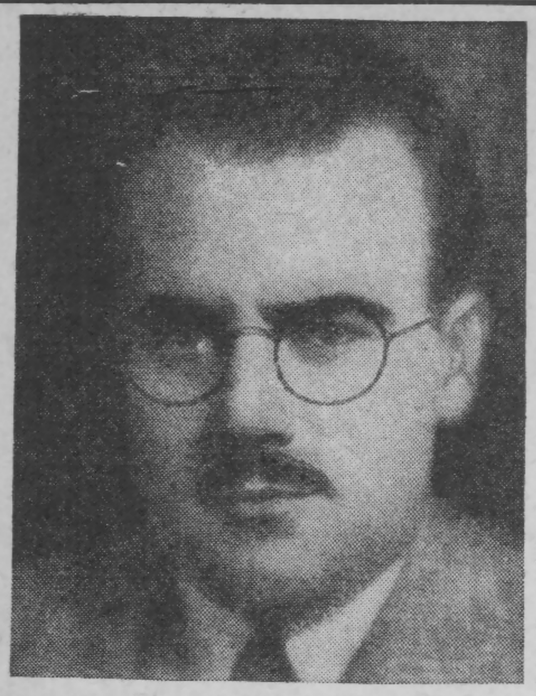

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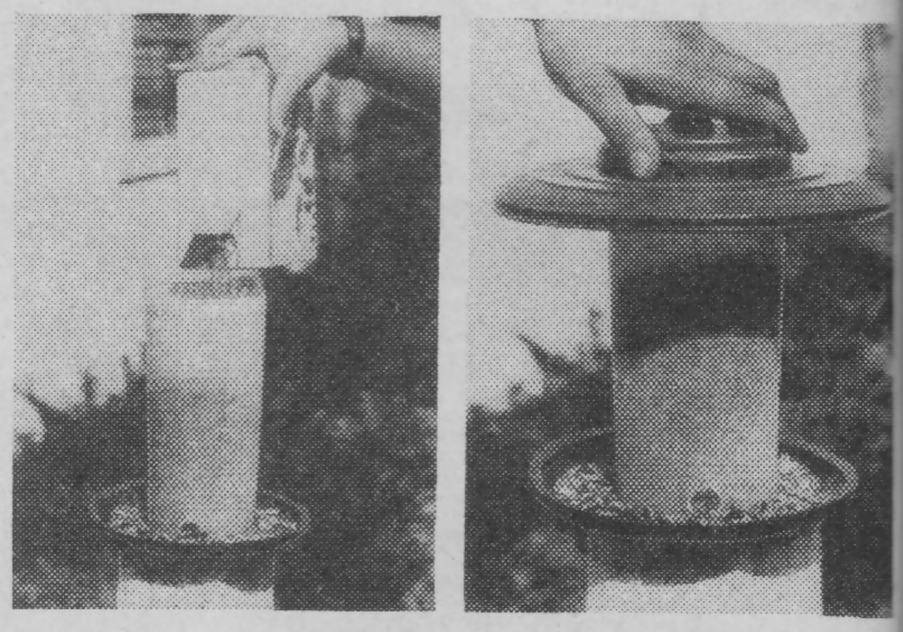

Drain holes in the tray prevent an accumulation of water. Priced at $1.98, the feeders are available in supermarkets, are made by the Plastray Corp., Dept. HMG, 1225 West Maple Road, Walled Lake, Mich.

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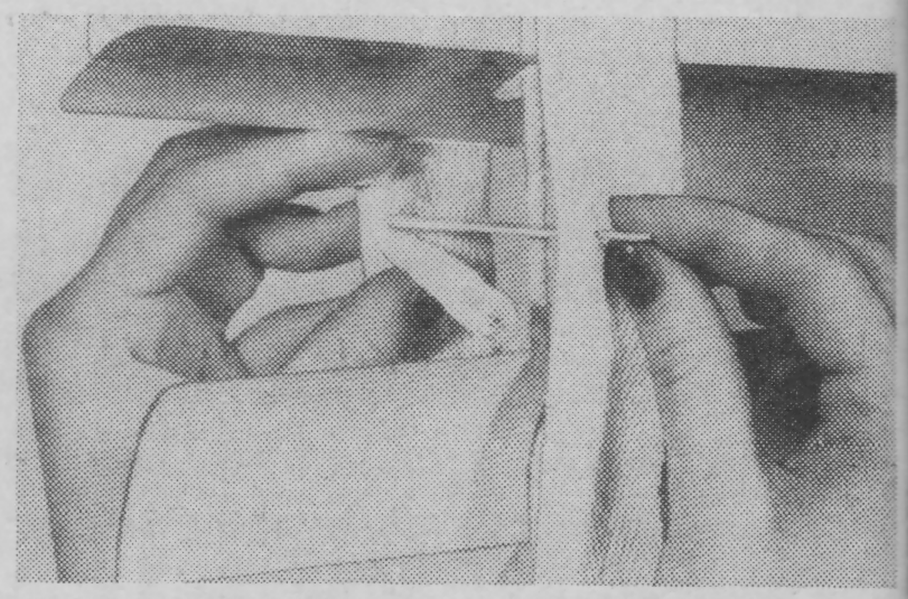
• Cross-ladders broken on those venetian blinds? A new 39¢ kit contains enough materials to repair 12 such cross-ladders. Instal-



lation of the new ones requires no tools or sewing. Made by Slat-Fix Co., Dept. SM, 72 Spruce St., Hicksville, L. I., New York.

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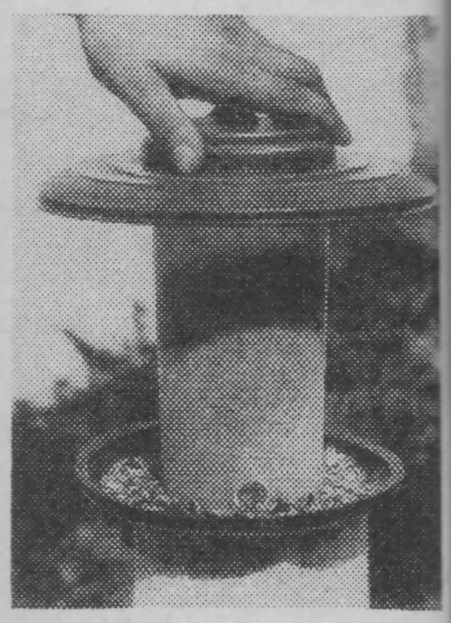

the tray prevent an accumula-
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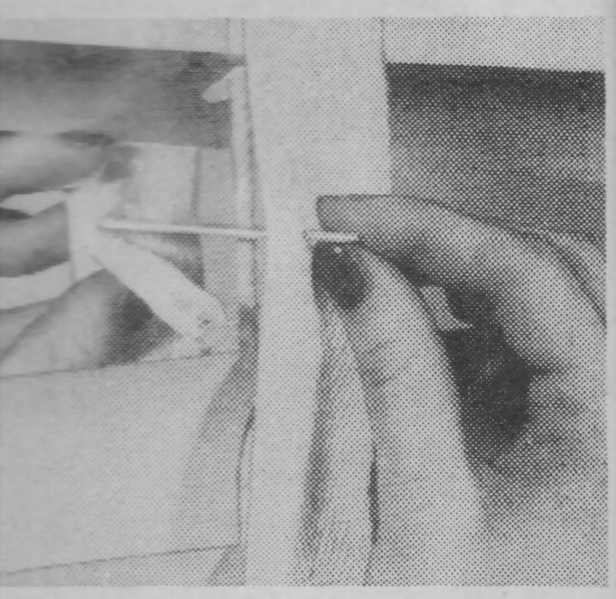
12 such cross-ladders. Instal-



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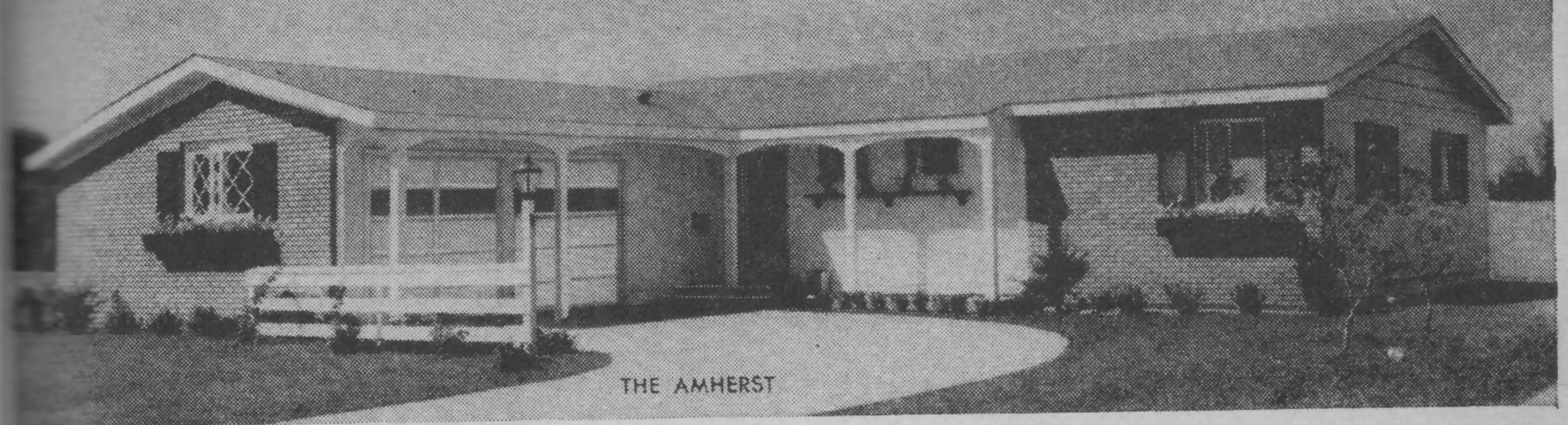

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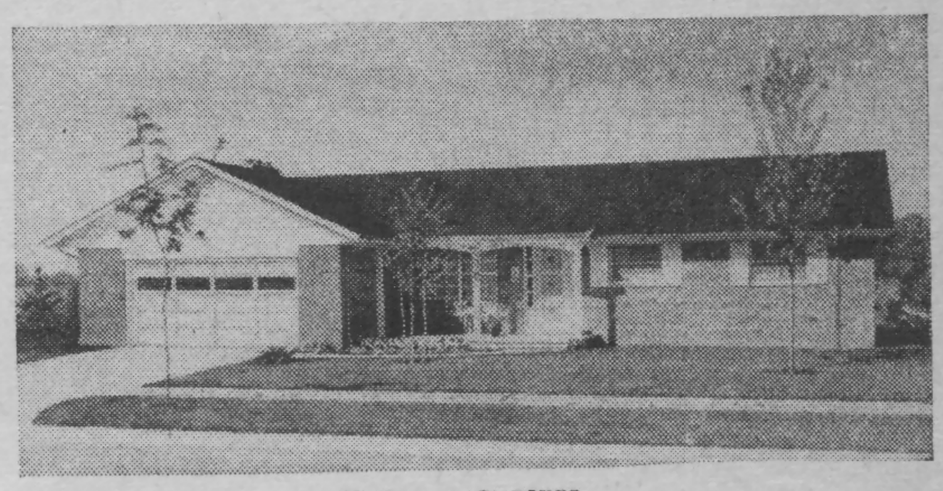

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Discharges tear gas to instantly stop, stun and incapacitate the most vicious man or beast. Effective substitute for firearms; leaves no permanent injury. No selling experience needed. Handle as profitable sideline, soon you'll sell it full time. Start now, 5 easy sales net $25.00 a day up. Send $5.95 for demonstration kit of Automatic Tear Gas Pencil, 10 demonstrators and 3 Tear Gas Cartridges. **NOT SOLD TO MINORS.** State age with order.

SELLS EASY TO SERVICE STATIONS, BAR-CAFE WORKERS, STORES, BANKS, LOAN OFFICES, HOMES

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FREE ★ BOOK **CLOGGED SEWERS** *REMEMBER THE COSTLY PLUMBING BILL—*

Attachable Cutter Blades

Start your Business

Electric Unit cleans pipes 3" to 12"

Chicago—Mar. 1st. Just introduced is a Free Booklet on machines which enable the Home Owner, Janitor or Factory Maintenance Man to Rod-it-himself—

Yet anyone can operate this **new Rodding Tool** which is whirled down the drain in a few seconds. SINKS, BATHTUBS, TOILETS, URINALS, FLOOR DRAINS, HOUSE TO STREET SEWERS can be cleared of Rags, Grease, Paper, Sand while Cutter blades can be added for removing roots. A new discovery in Swedish Music Wire gives the rod 100% more Flexibility.

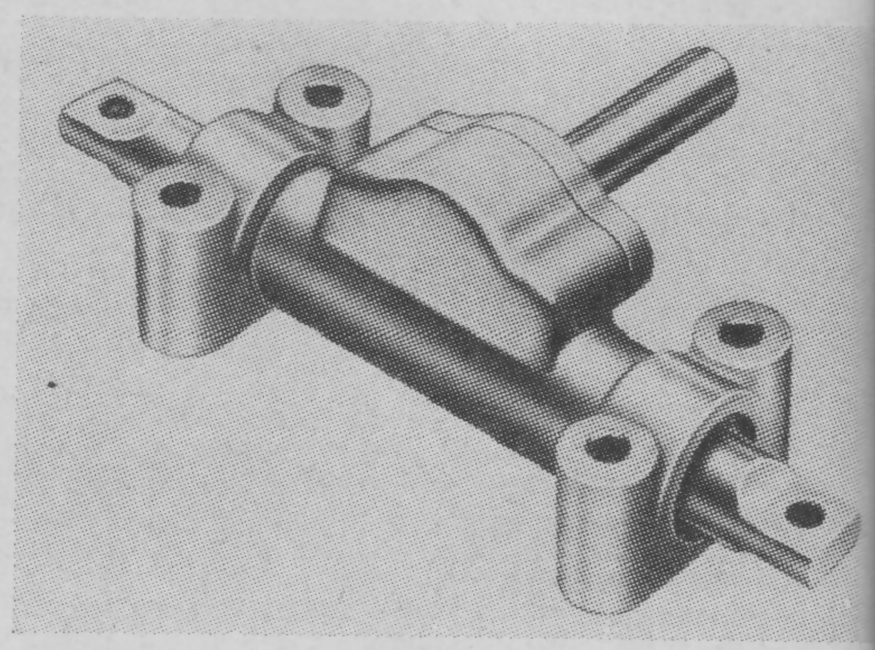
Another new unit is the Miller Electric Rodder which has patented cutters that expand automatically to the size of the pipe. It will clean out heavy obstructions in pipe diameters 3" to 12". Smaller Sizes available. But now, what are these Tools worth in **COSTLY PLUMBING BILLS SAVED.** Tear This Ad out—and write your name and address beside it for **FREE BOOKLET** on Hand and Electric Units. Obey that urge. No Agent will call. A postcard will do (Chicago Phone Kildare 5-1702).

Miller Sewer Rod, Dept. SR-4, 4640 N. Central, Chicago 30, Ill.

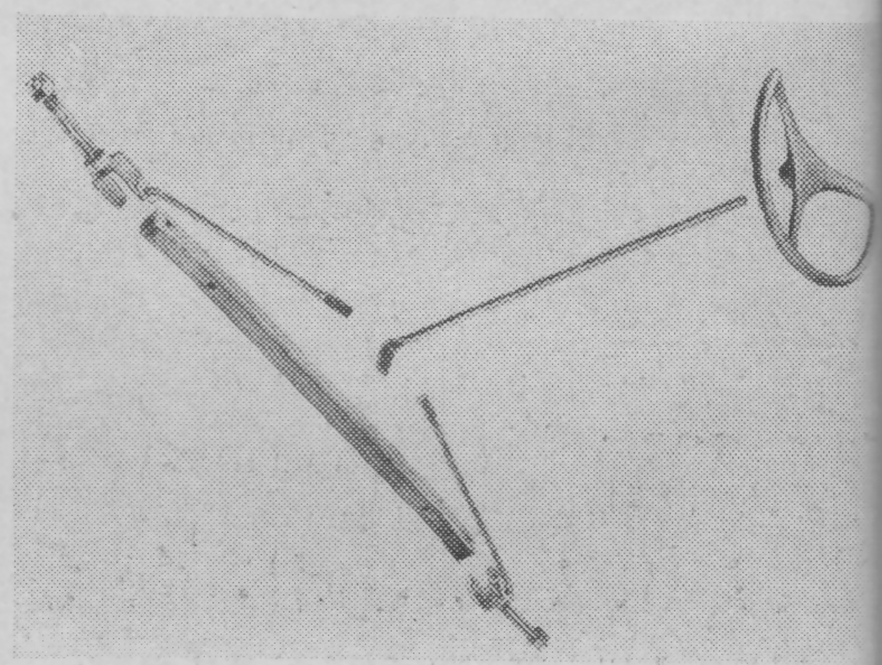
3 x 5-ft. flag or pole mounting. Priced at $ from Mackley Trading Co., Dept. H12, 112 Broadway, New York 10, N. Y.

Steering Unit and Front End Assembly for Carts

• A new rack and pinion gear reductio steering unit for use in carts, riding law mowers and small tractors features a 3-1 gea reduction that eliminates over-steering an permits full revolution of steering wheel fro left to full right. Plated steel rack and pi ion is housed in a cast aluminum body. En



Above, rack and pinion gear reduction steering unit. Below, front end assembly.



tire unit can be universally mounted. De signed for use with a ⅜-in. or ¼-in. clevis o ball joint, the rack as well as the mountin pads rotate 360°. Front or rear drag lin mounting possible. Price is $14.95.

Aso available is a $24.95 front end assem bly for carts, said to make driving easier an safer. Assembly includes a ½-in. dia. steer ing wheel in round or kidney shape. Optiona equipment includes pedal brackets attache to the axle, steering column brackets fastene to the axle and cast aluminum pedals. Both assemblies are made by the Dexon Mfg. Co. Dept. MAA, 4116 Cedar Ave., Minneapolis Minn.—P. D. URBAIN.

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FLOWER-MATIC is a

- Unrolls on Garden soil
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FLOWER-MATIC is available in DWARF BORDER assortments. A year. Many will re-seed and bloo

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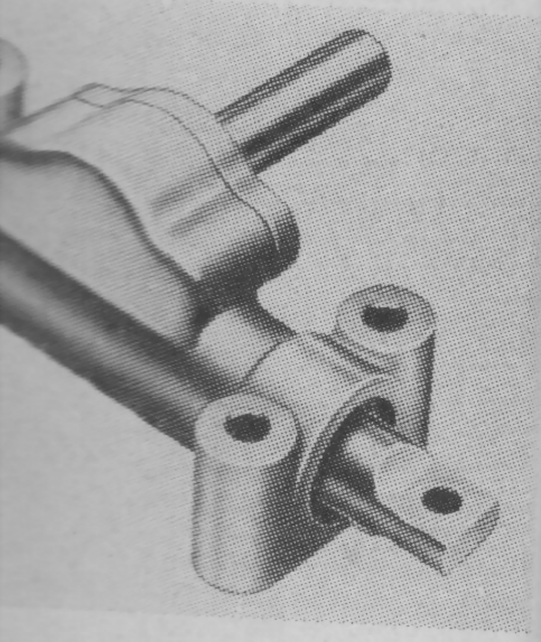
a cast aluminum body. En-



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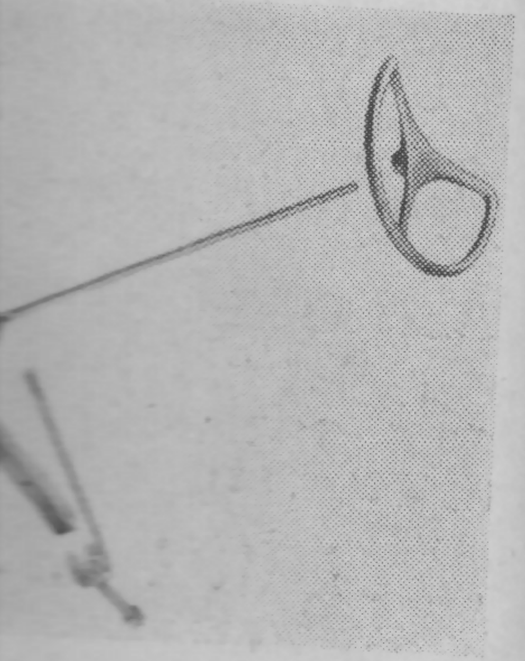
ront end assembly.



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ARMLOADS OF CUT FLOWERS DAILY

Think of it! Your own beautiful Garden of Flowers some FOUR FEET tall, or a dazzling drawf flower border framing your property. FLOWER-MATIC assures you of an endless supply of fragrant, dewy-fresh flowers daily. Enjoy these exquisite beauties in a glorious assortment of colors — gay lavenders and pinks, sunny yellows, frothy whites, cool blues, flaming reds and oranges with many giant blooms UP TO 6 INCHES ACROSS.

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"Hope your offer is available this year. Last year the Flowers were fabulous." **M. J. S., Roscoe, Ill.**

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(These are only a few excerpts from the many letters received from delighted customers.)

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- ZINNIA*
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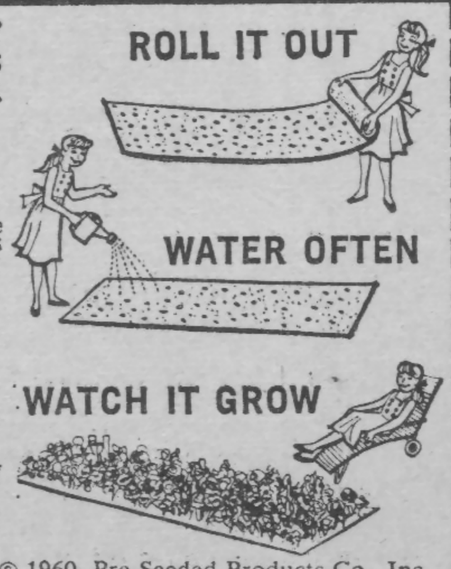

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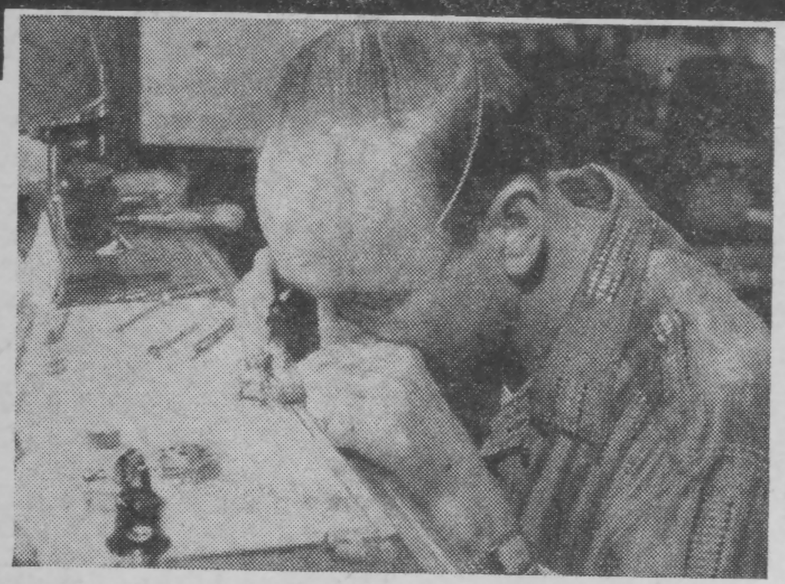

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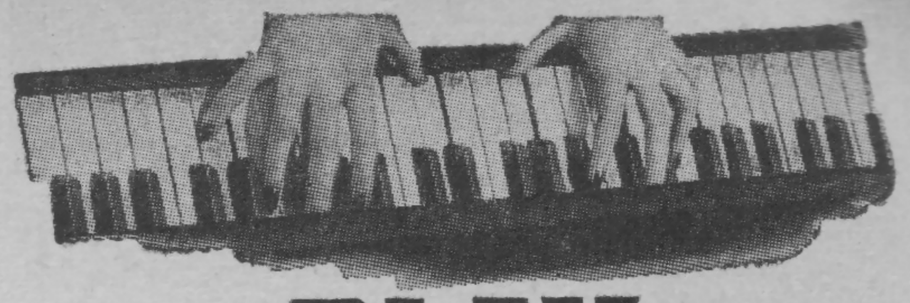

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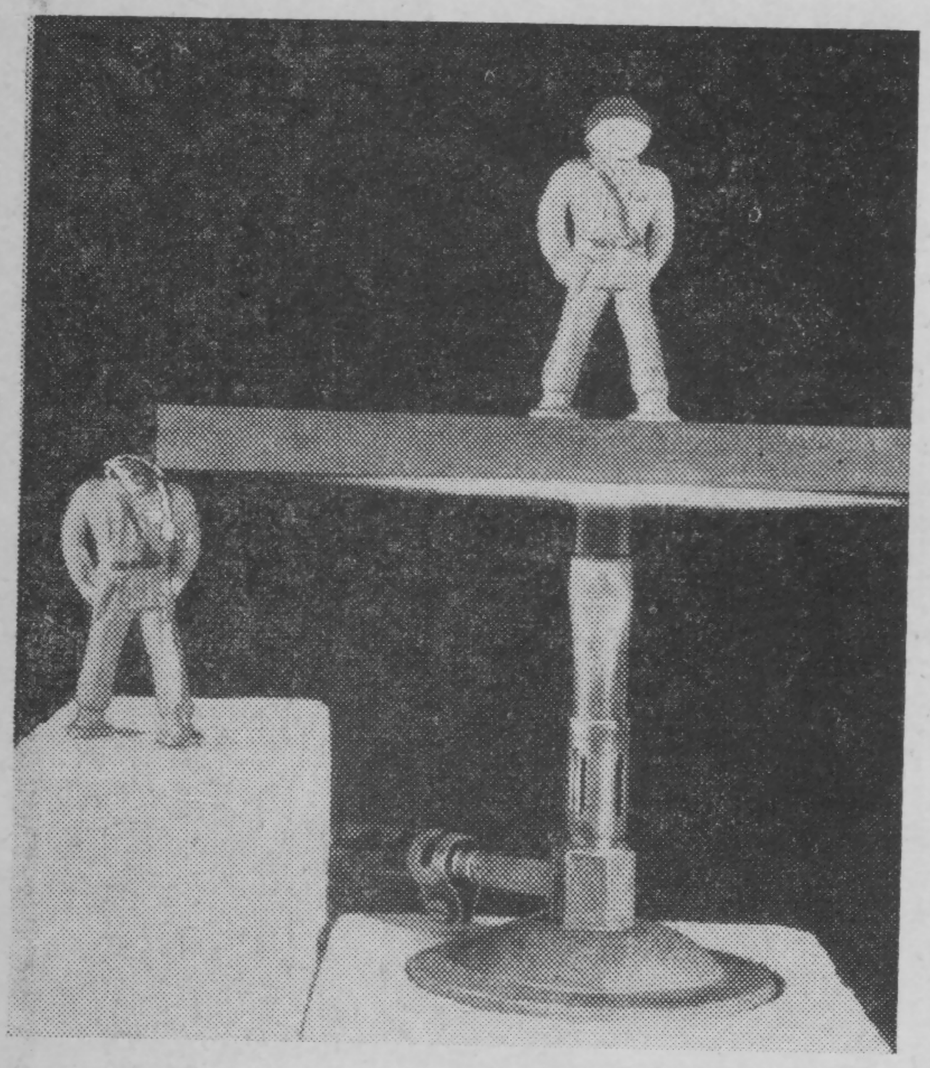
Science Briefs

A half-century-old scientific curiosity has been turned into a practical commercial material that conducts heat 500 times better along its surface than through it. Note in the photo how heat from the torch melts the head of the lead soldier at left, while its companion on top is relatively unaffected. Called *Pyrographite* by its developer—the Raytheon Co., Waltham, Mass.—the lightweight material can



withstand temperatures up to 6700° F. It may solve many of the high-heat problems in the missile, nuclear reactor and industrial fields. A high purity form of carbon or graphite, it has been known to scientists for some 50 years, but only recently have they been able to harness its properties.

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Holes under streets—which could lead to dangerous cave-ins — can be detected by a supersensitive gravity meter developed by Texas Instruments, Inc., Houston, Tex. It works on the theory that a cavity—in effect, the removal of an attracting mass—should be accompanied by a small but detectable decrease in gravity. The meter has a small weight at the end of a delicate spring. Over a cavity—even one as small as 23 cubic feet —the gravity is slightly less than over adjacent solid ground, so the spring contracts, and this is measured through use of a microscope.

Contrary to what many scientists believe, the Earth is solid down to its core—some 1800 miles down—says a National Aeronautics and Space Administration scientist. Dr. John A. O'Keefe bases his belief on last year's discovery that the Earth is slightly pear-shaped and a recent determination of how much it is flattened at the poles. A strong mechanical strength — equivalent to building brick — is needed to support the pear-like shape, he says. Therefore, there can be no convection currents slowly churning over large masses of rock, as has been thought.

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Ever hear the terms "tera," "giga," "nano" or "pico" before? Probably not, because they're new prefixes recently adopted by the National Bureau of Standards to denote very large and extremely small quantities. Tera indicates a trillion and giga a billion. Nano is the prefix meaning a billionth, and pico, a trillionth. Complete with decimal point and zeros, pico looks like this—0.000,000,000,001.

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About one out of every seven meteors entering the Earth's atmosphere is nothing but a fragile piece of dust. Dr. Richard E. McCrosky, of Harvard College Observatory, Rochester, N. Y., says photographs taken with a meteor camera reveal that some 15% of the "shooting stars" have a density about a twentieth that of water and the consistency of cigarette ashes.

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Look for a new type of man-made rubber to show up soon in shoe soles, floor tiles and coverings for cables and golf balls. The new material, a polybutadiene, can be molded, melted and milled like a plastic—and is equal in hardness and resilience to natural rubber, although not as elastic. Like rubber, however, it can be vulcanized, says the Phillips Petroleum Co., Bartlesville, Okla.

˅ ˅ ˅

Tomorrow's solar-cell power plants may be made from a new high-heat material compounded from two chemical elements, each of which alone would melt on a hot day. The two low-melting elements are gallium and phosphorus. Together, they make up galium phosphide, a yellow compound resembling ground glass which can withstand temperatures up to 1500° F. The U. S. Army Signal Corps Research and Development Division, Fort Monmouth, N. J., is carrying on more research to determine the material's properties before passing it on to equipment development engineers.

˅ ˅ ˅

Three New York University scientists have demonstrated one way in which radiation kills. At the same time, they may also have explained mutations and gene changes. They have found that radiation knocks a hydrogen

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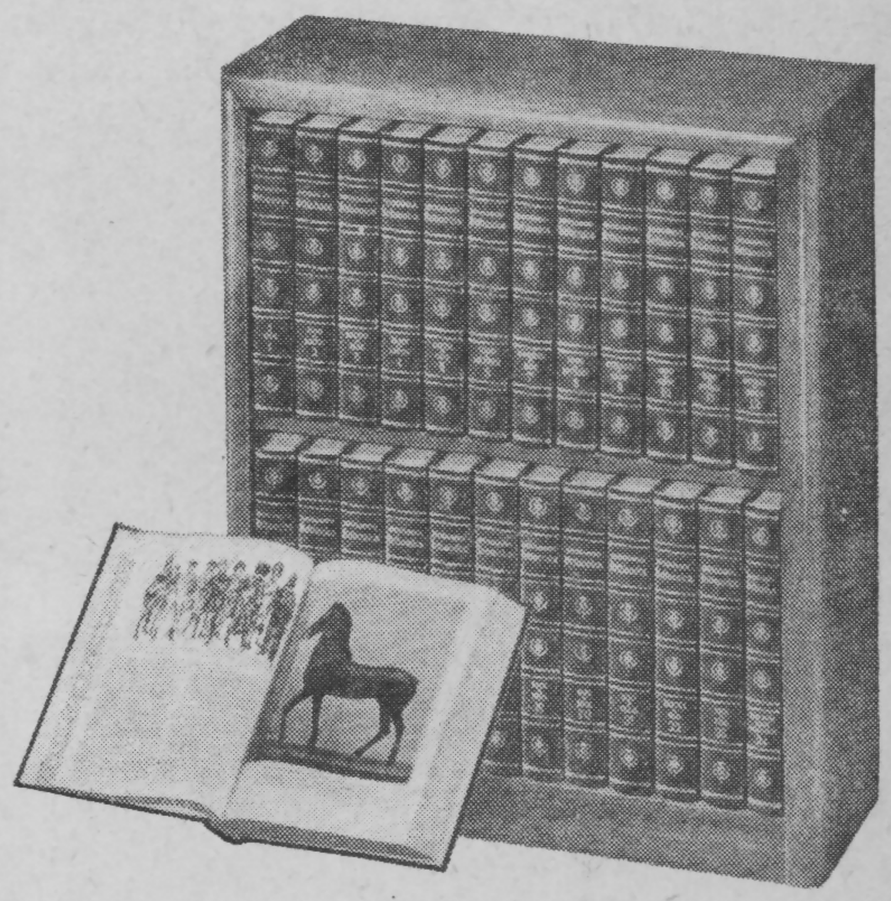

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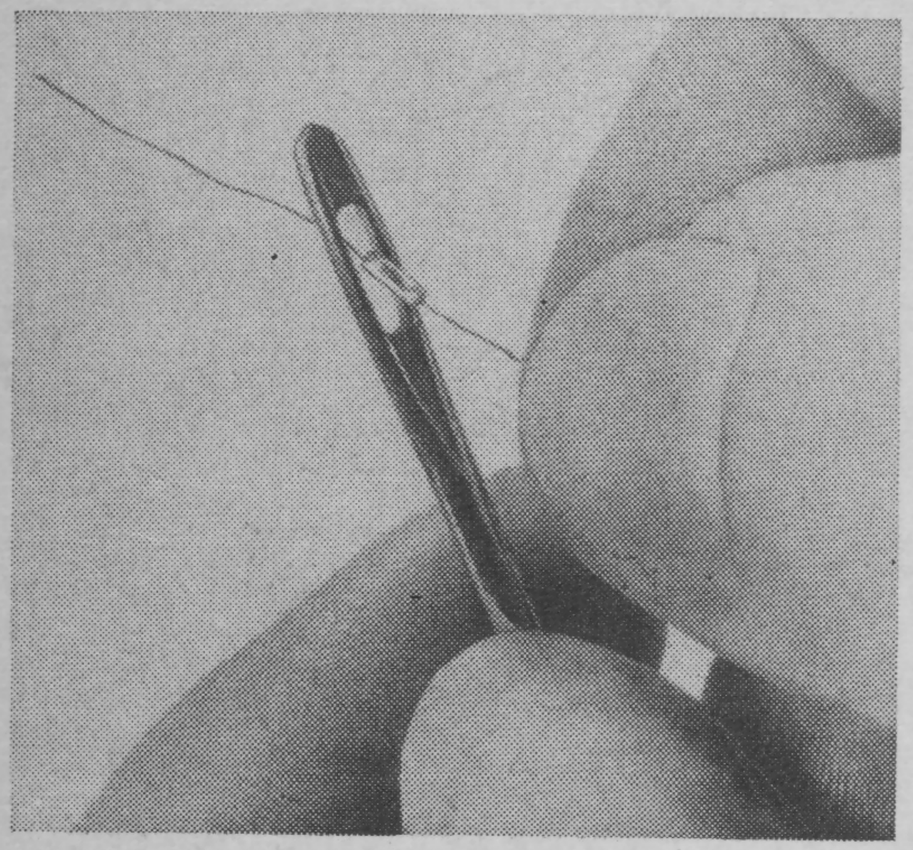
v v v

So small it can pass through the eye of a darning needle, a new incandescent lamp is expected to find widespread use in miniature transistor circuitry. It is particularly adaptable to indicating devices. Its light output is 100 millilumens at 1½ volts input, and



its filament is less than 1/10 the diameter of a human hair. The manufacturer—Sylvania Lighting Products, Salem, Mass.—expects it to find immediate application in airborne electronic systems, high speed punch-card and tape readout devices, compact matrix displays, photoelectric logic systems and other circuits.

v v v

Mass production of silicon semiconductors will be made easier by a newly developed black glass that is impervious to light. It filters out most wavelengths of the ultraviolet, visible and near-infrared spectrum—to which silicon semiconductor crystals are sensitive. The glass will be used in the form of beads and cases to enclose the semiconductors, ending the need to paint them and the problem of surface scratches. It has resistivity similar to the bulb glass used in standard radio tubes, says the manufacturer, Corning Glass Works, Corning, N. Y.

Evidence is piling up that planets of stars other than our sun very likely have evolved forms of life. Organic molecules recently were discovered in stony meteorites by Dr. Melvin Calvin, a chemist at the University of California. Scientists believe these types of molecules were intermediate in the evolution of chemical forms from inert to living material.

Another scientist, Prof. Thomas Gold, director of the Center for Radiophysics and Space Research at Cornell University, Ithaca, N. Y., has posed the provocative speculation that life on Earth may have begun from germs and garbage left here by exploring space travelers a billion years ago. Dr. Gold suggests that spacemen from Earth may in turn contaminate other lifeless planets and start another cycle of evolution and exploration.

v v v

A new insulating material can be painted or sprayed over standard insulation on electrical equipment to give up to 300 times more resistance to electrical arcing. Developed by Westinghouse Electric Co., Pittsburgh, Pa., the insulation is a resin of the epoxy type and dries to form a smooth painted surface.

v v v

A water-like fluid that can make a smooth paint surface so slick that dust and dirt cannot cling to it has been developed. Simply mix the fluid, called *Du Pont Soil Retardant Concentrate,* with water and apply it to an interior or exterior painted surface as thinly as possible. The secret of the new coating is that it fills the microscopic pores of the seemingly smooth painted surface, producing such a completely slick surface that there is virtually nothing for dirt to adhere to. It is made by Du Pont Finishes Division, Wilmington, Del.

v v v

Fruit flies, sent 15 miles into the sky in a balloon, have survived with no apparent genetic damage, reports the U. S. Department of Agriculture. The U. S. D. A. says that still more tests are needed, however, to find the effects of cosmic rays on humans at such altitudes.

v v v

By pumping enormous amounts of electricity into a tiny wire—causing it to explode—scientists have found what may be a promising way to power space rockets. Working at Electro-Optical Systems, Inc., Pasadena, Calif., they have obtained specific impulses (the rocket engineer's equivalent of *mpg*) far superior to those of chemical fuels, they report. The scientists are using aluminum wire through which electricity from a 10- to 20-kilovolt source is discharged in .000,000,007 of a second.

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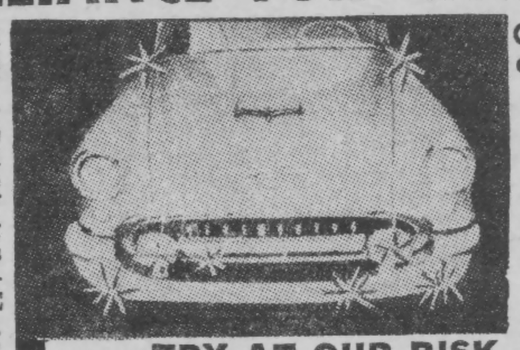

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Here's To Your HEALTH

Drinking milk is a good protection against strontium-90—a radioactive fission product released by atomic bombs. The Sr90 has less effect on the body when it is consumed with calcium-abundant milk, says Dr. Bruce L. Larson, a biochemist in the department of dairy science of the University of Illinois. Cows, he says, have organic mechanisms which eliminate most of the Sr90 in their food. Humans also have such screening mechanisms in the intestinal tract and kidneys, which further reduce Sr90 content.

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Your aching tooth may show up on closed circuit television soon. A new device that can peer into your mouth, then project what it sees onto a TV screen, has been developed by the Avco Corp., Wilmington, Mass. Key to the system is an optical fiber probe, a cable containing up to 10,000 hair-like, light transmitting fibers with a finger-tip size lens on its probing end. It transmits light in either direction, thus illuminates the tooth while it sends back a picture. Besides aiding in diagnosis, the probe is expected to find widespread uses in medical and dental schools.

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If you're a bowler, that follow-through can do more for you than insure a well-placed ball. Dr. James R. Hoon, Sheboygan, Wis., warns that *not* following through—but instead stopping suddenly at the foul line—can lead to strained thigh muscles.

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The iron lung soon may be replaced by an electronic lung which can give the patient using it considerable freedom of movement. Instead of being encased in a box, he will be linked to the machine by two plastic tubes. Called the Barnet Ventilator, the new lung is portable, has built-in batteries which run it up to 20 hours without recharging and is manufactured by W. Watson and Sons, Ltd., Cambridge, England.

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Music hath charms to kill the pain of the dentist's drill, according to a team of researchers in Cambridge, Mass. Drs. Wallace J. Gardner, a dentist, and J. C. R. Licklider, a psychologist, have found that toned-down stereo sound creates a diversion, and thus is an effective pain killer for many dental patients—especially children. They use an instrument which has earphones that can bring the patient music or a roaring sound like Niagara Falls at any volume he chooses.

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Niacinamide	40 Mg.	Intrinsic Factor Conc.	1/50 USP unit	Magnesium	5 Mg.		
Vit. C	100 Mg.						
Vit. B_6	0.5 Mg.						
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Vit. K	0.1 Mg.						
Vit. B_{12}	5 Mcg.						
Choline	35 Mg.						
Inositol	20 Mg.						
Rutin	10 Mg.						
Paba	10 Mg.						

Copper	1 Mg.				
Potassium	1 Mg.				
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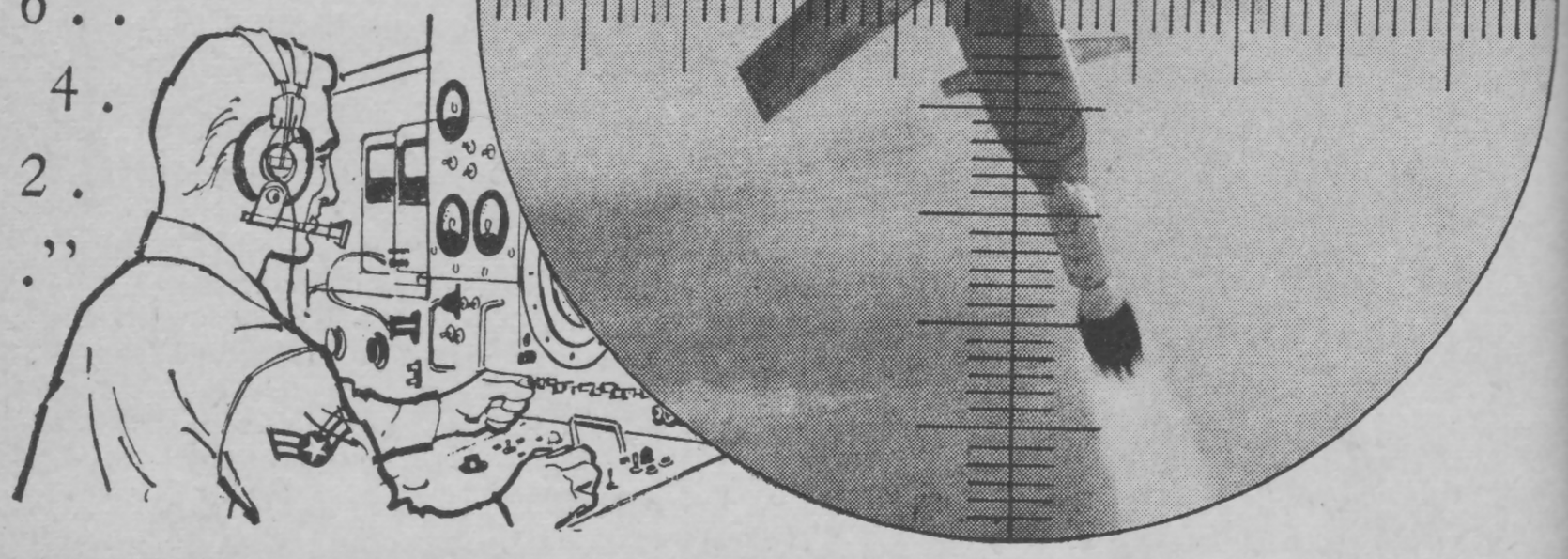

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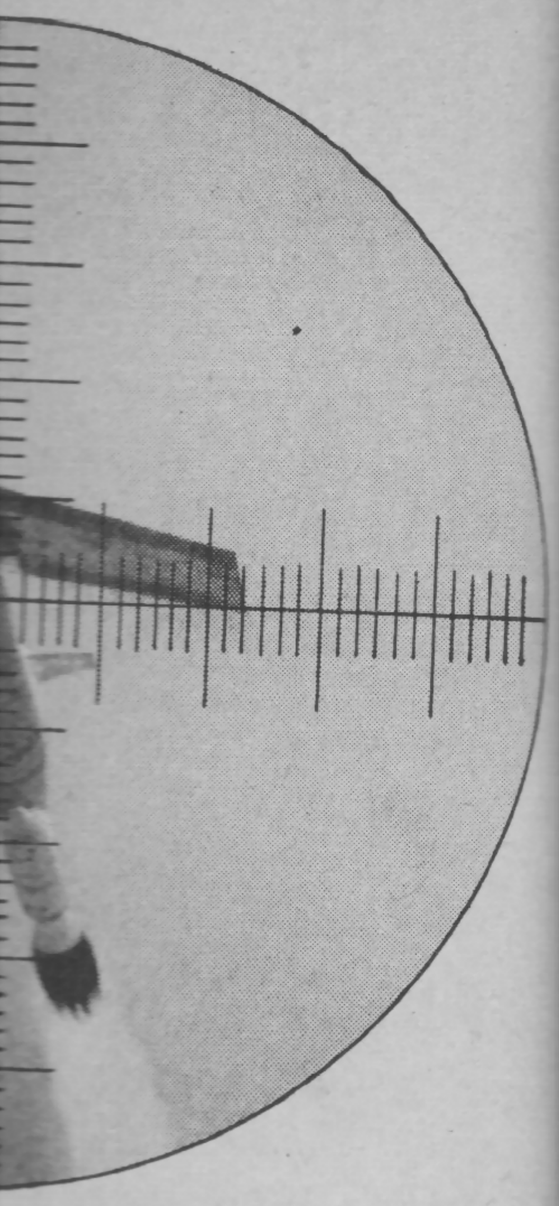

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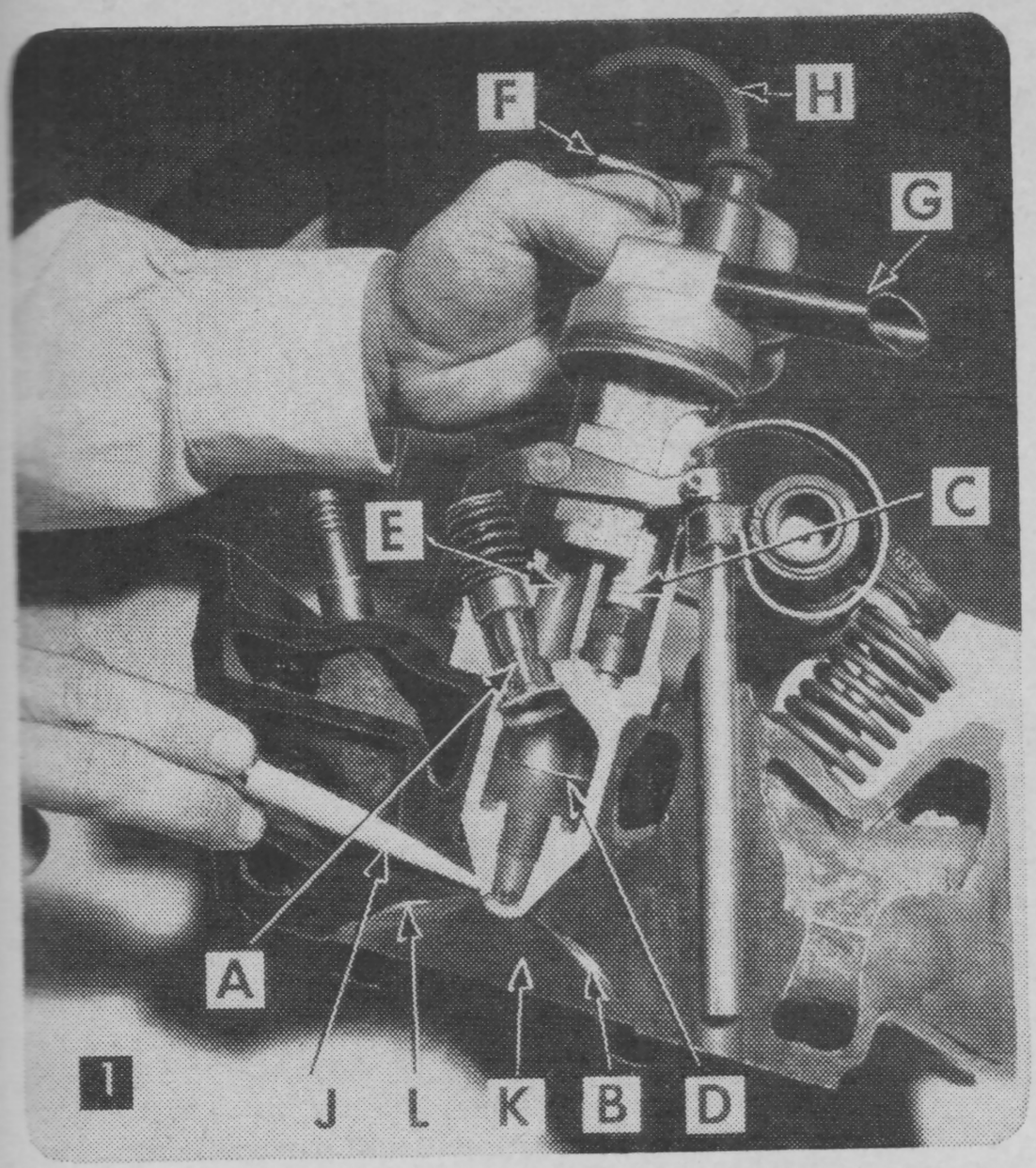


SCIENCE and MECHANICS

APRIL 1960

Cutaway of typical gasoline engine cylinder block and cylinder shows how Straticharge unit fits in spark plug well. Components are: (A) Air-fuel inlet valve mechanically coupled to heel of cylinder inlet valve's rocker arm; (B) Cylinder air inlet valve; (C) Spark plug; (D) Pre-combustion chamber; (E) Pre-combustion chamber's air-fuel inlet; (F) Fuel line to pre-combustion air-fuel inlet; (G) Air line to pre-combustion air-fuel inlet; (H) Wiring to spark plug; (J) Pencil points to small ports which connect pre-combustion chamber with cylinder; (K) Cylinder, and (L) Cylinder exhaust valve.

Convert Your Car to Any Fuel—and Save Money

Here's the full story on a new combustion system that can be fitted to your car's engine. It promises 30% fuel savings, lower maintenance costs and smog-free operation

Drawings compare RAM Straticharge combustion (right) with conventional spark-ignited gasoline engine (left) and diesel (center). Gasoline engine mixes fuel and air in carburetor, then passes it directly into cylinder for spark-ignition. Diesel compresses air in cylinder until it is hot enough to self-ignite, at which time fuel is injected directly into main cylinder. RAM Straticharge mixes air and fuel in pre-cup, then spark-ignites part of it. This rams the fuel-rich mixture into the extremely lean fuel-air mix in the cylinder, where combustion occurs.

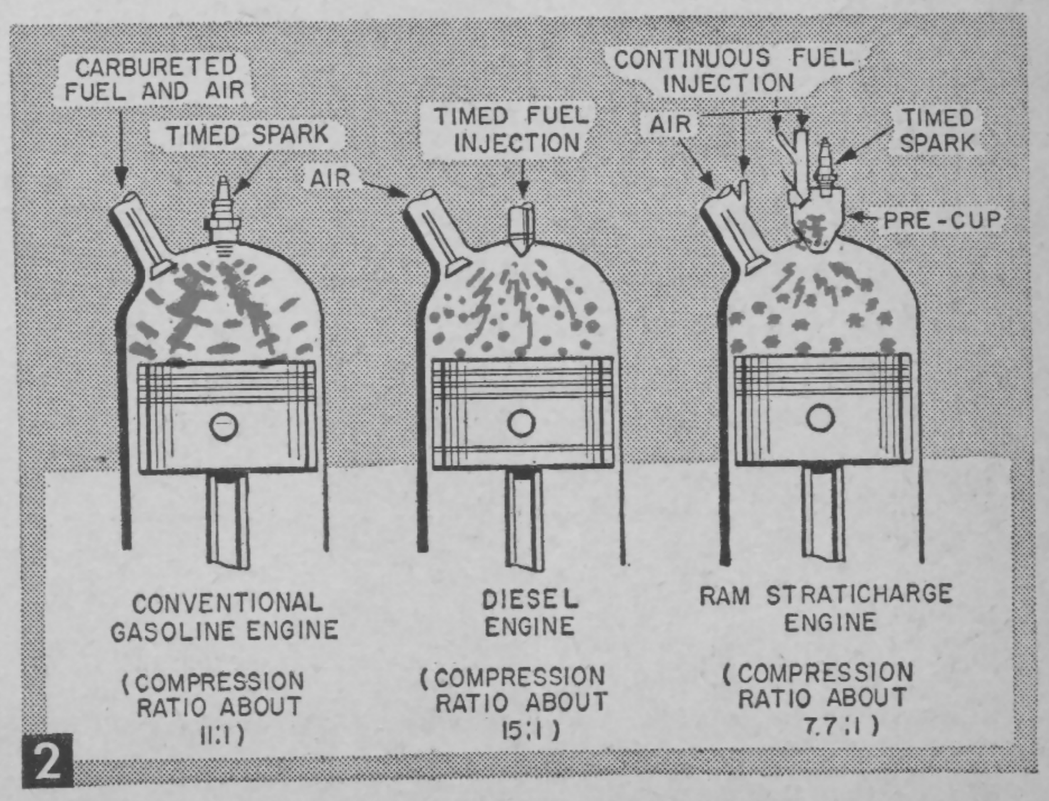
By JAMES JOSEPH

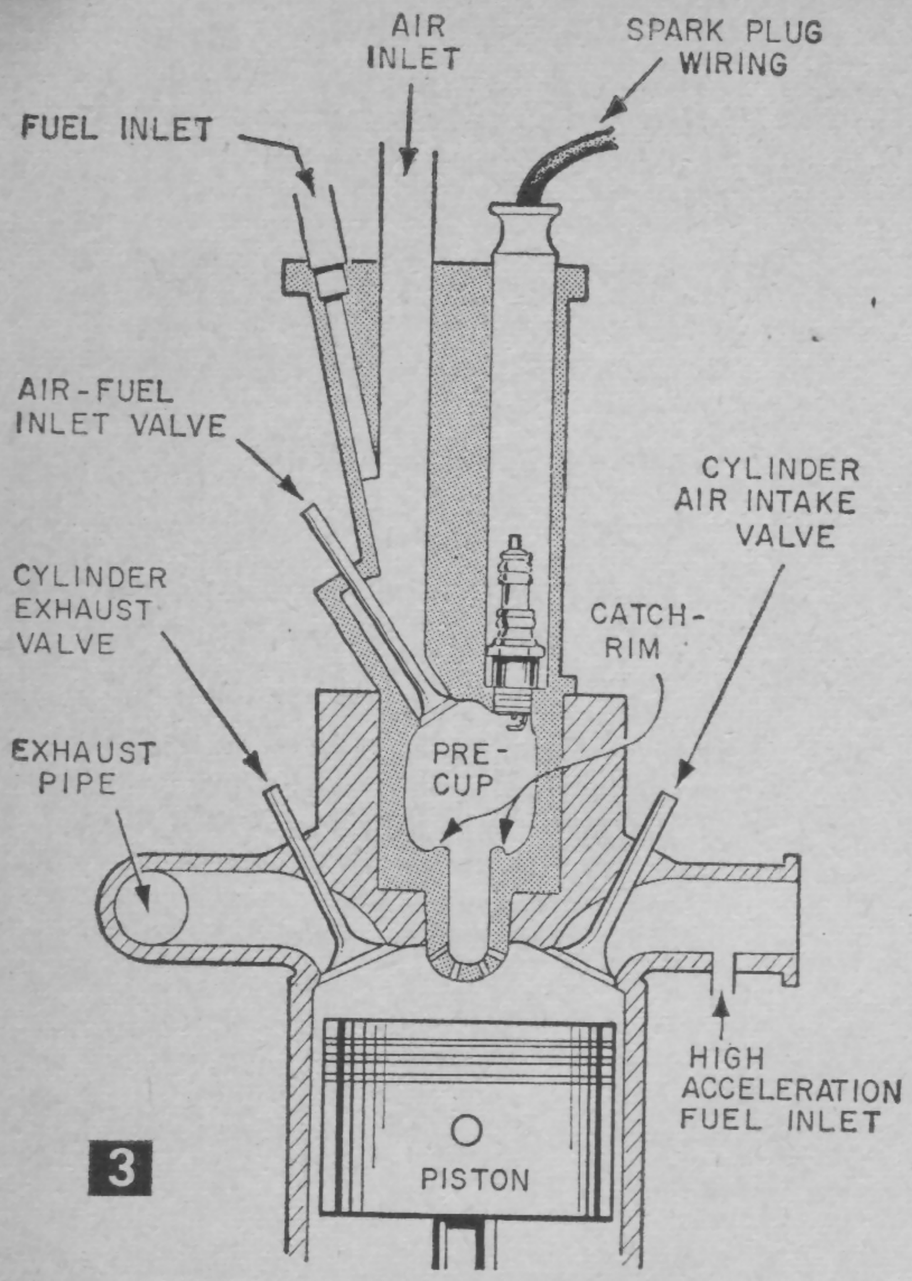
"OCTANE" is a word seemingly headed for oblivion.

What promises to make it obsolete is a remarkable new combustion system, the RAM Straticharge.

Added to your car's gasoline engine, it would permit you to burn anything that's cheap and handy: diesel oil, no-lead white gas, naphtha—even jet fuel.

Your straticharged engine would burn them all. And, according to





How RAM Straticharge works. Fuel, constantly dribbled into air-fuel inlet, collects above air-fuel inlet valve. When valve opens, fuel and air flow into pre-cup. Fuel lodges in bottom of chamber and around catch-rim. The Stratified, fuel-lean mix in top of chamber contacts spark plug and is ignited. Explosion rams fuel-rich mix in bottom of pre-cup, through small holes into nearly pure air of cylinder, where combustion takes place. At high acceleration, extra fuel is injected ahead of air inlet valve into cylinder airstream.

tests made by Dr. A. L. London, professor of mechanical engineering at Stanford University, fuel economy would be 10 to 15% better than with conventional carbureted systems—and could be doubled if really low-cost fuels were used.

The RAM Straticharge unit is quite simple: You start by pulling your present spark plugs and removing your present carburetor. Then you substitute for each cylinder's spark plug a pre-combustion chamber weighing about three pounds.

4

This chamber—the heart of the RAM Straticharge conversion—combines a "cup" (where initial combustion occurs), a spark plug (slightly smaller in diameter than the ones your engine now uses) and a fuel-air inlet valve (see Fig. 1).

Cost of conversion will probably be less than $200 for the average 8-cylinder auto engine. Moreover, conversion is a job any fellow could handle in his own garage, providing he's hep to automobiles.

Straticharge's inventor is 67-year-old Ralph M. Heintz, a well-known engineer, the holder of more than 200 patents and the retired partner of Cleveland's famed Jack and Heintz, Inc.

Here, in an interview with SCIENCE AND MECHANICS, Mr. Heintz discusses his RAM Straticharge—and its significance for the average car owner:

Q. Mr. Heintz, could any car owner convert his car's present gasoline engine to the RAM Straticharge system—once it's on the market—without major changes in the engine itself?

A. Yes. The major change is incorporated in the small pre-combustion chambers which replace the carburetor and spark plugs. On on 8-cylinder engine, for example, you'd have eight pre-combustion chambers—one for each cylinder. The chamber fits into the spark plug well. In some cases, however, the well must be modified a bit—enlarged and tapered. The pre-combustion chamber is simply slipped into the well and held to the head with four studs.

Q. What about other engine modifications?

A. Each cylinder is drilled for an auxiliary fuel injection port—which directly injects fuel behind the main cylinder's air intake valve when the engine is accelerated, say at speeds above 60 or 65 *mph*.

Q. And with these simple modifications a car's engine can burn any fuel?

A. Any fuel that is capable of ignition by the spark plug. There's only one fuel criterion: will it ignite? If it will, it's a suitable fuel.

Q. A motorist, then, might fuel his Straticharged car with anything available.

A. Yes. Just about anything handy. The Straticharged engine burns them all and doesn't know

Straticharge's inventor is 67-year-old Ralph M. Heintz. Says Heintz in interview with SCIENCE and MECHANICS: "There is just one fuel criterion—will it ignite? If it will, it's a suitable fuel for the Straticharged engine."

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the difference, one fuel to the other. Nor does it care about octane, cetane or lead. You can fuel with alcohol one day, then switch to butane or kerosene mixed with gasoline the next. Or burn a mix of light diesel oil and gasoline.

Q. The Straticharged engine won't burn straight diesel fuel?

A. It'll burn it—but it won't cold start. To start, you'd need glow plugs. Once started, though, the engine performs well on diesel fuel, especially diesel fuel mixed with a small amount of non-lead gasoline.

Q. What explains the fuel savings, reduced maintenance and two-thirds less smog-producing hydro-carbons in the exhaust?

A. The real secret—if you want to call it that—lies in how the Straticharged engine combusts. It's not only that we burn less fuel, but that we burn nearly every drop of it. There's simply nothing left to exhaust. Because nearly all the fuel is burnt, you get maximum power from every fuel molecule, thus better performance.

Q. How does the RAM Straticharge work?

A. What happens is this: Fuel and air are pumped into the pre-combustion chamber through the air-fuel intake. This "charge," you might call it, is fuel-rich. Meantime, in the main cylinder, there's only air. As in the diesel, it's being compressed as the piston rises toward the top of its stroke. Compressed though this air is, however, there isn't enough of a temperature rise to ignite a fuel charge—if one, at this moment, were injected into the cylinder.

Q. And then?

A. Then the upper portion of the rich mixture in the small pre-combustion chamber—we call it a "cup"—is spark-ignited. The explosion hurls the fuel-rich mixture through ports in the cup's bottom, directly into the nearly pure air in the main cylinder where there is oxygen enough to burn every molecule of fuel.

Q. And that prefix "RAM" describes how the fuel charge, in the cup, is hurled into the main chamber?

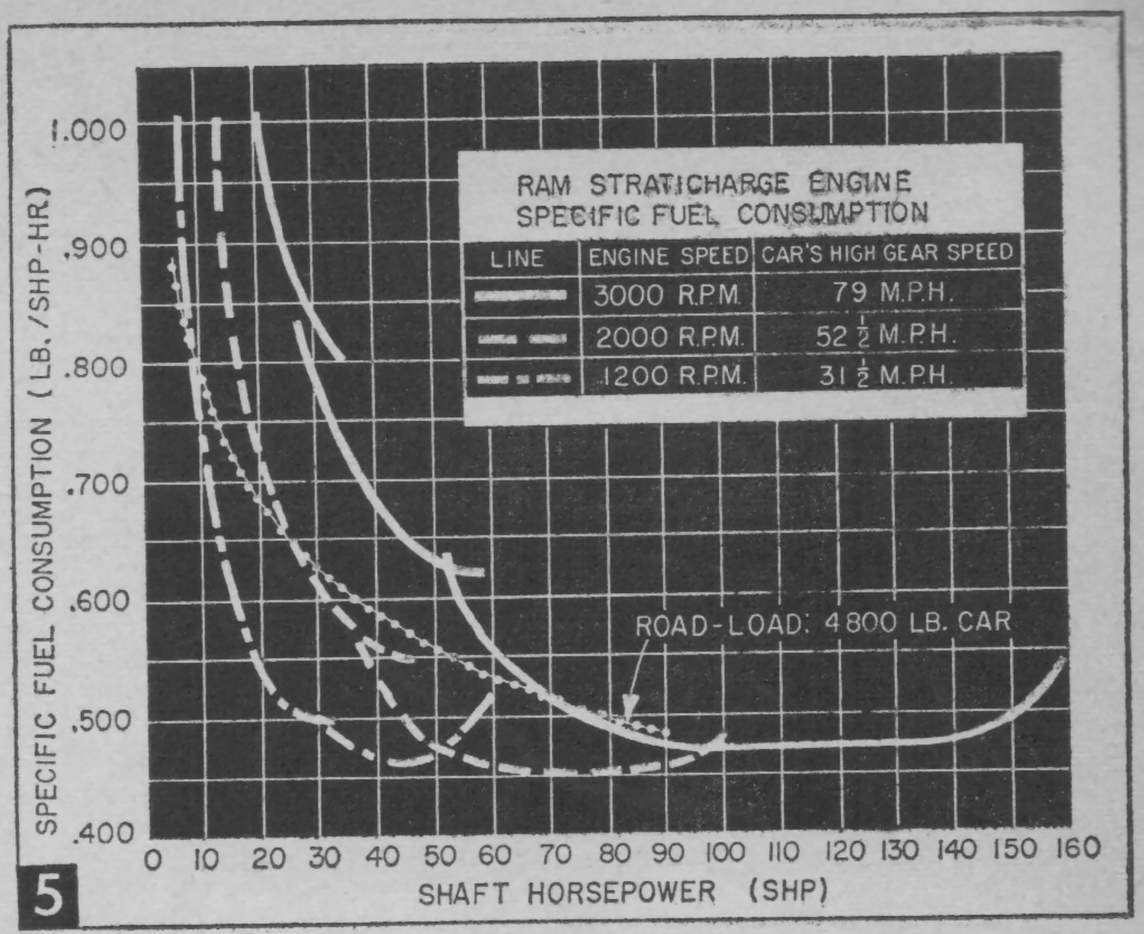
A. That's right. When the spark ignites the cup's mixture, it drives—actually explodes—a fuel-rich charge into the main cylinder. Ramming velocity is pretty high, several thousand feet per second. As the hot charge—I liken it to a myriad of tiny torches, each well over 3000° F—hits the nearly pure air in the main cylinder, secondary combustion occurs. Combustion that's nearly 100%. That is, in the presence of so much air, just about all the injected fuel is burned.

Q. How does this compare to a standard gasoline engine?

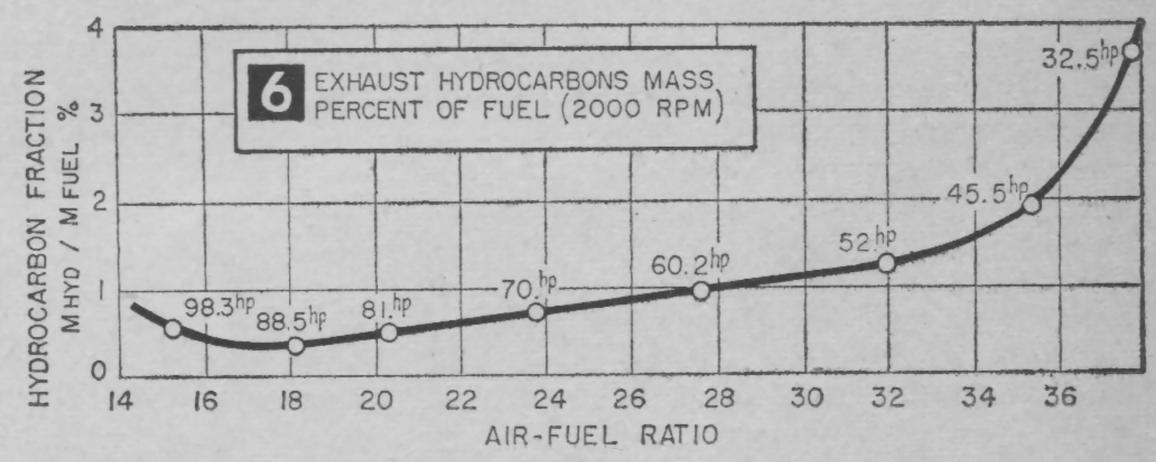
A. Well, let's talk about combustion in your present car's engine. It combusts a fuel-rich mixture. And because there's simply not enough air for complete combustion, the gasoline engine inherently can never burn all its fuel.

Q. How much can't it burn?

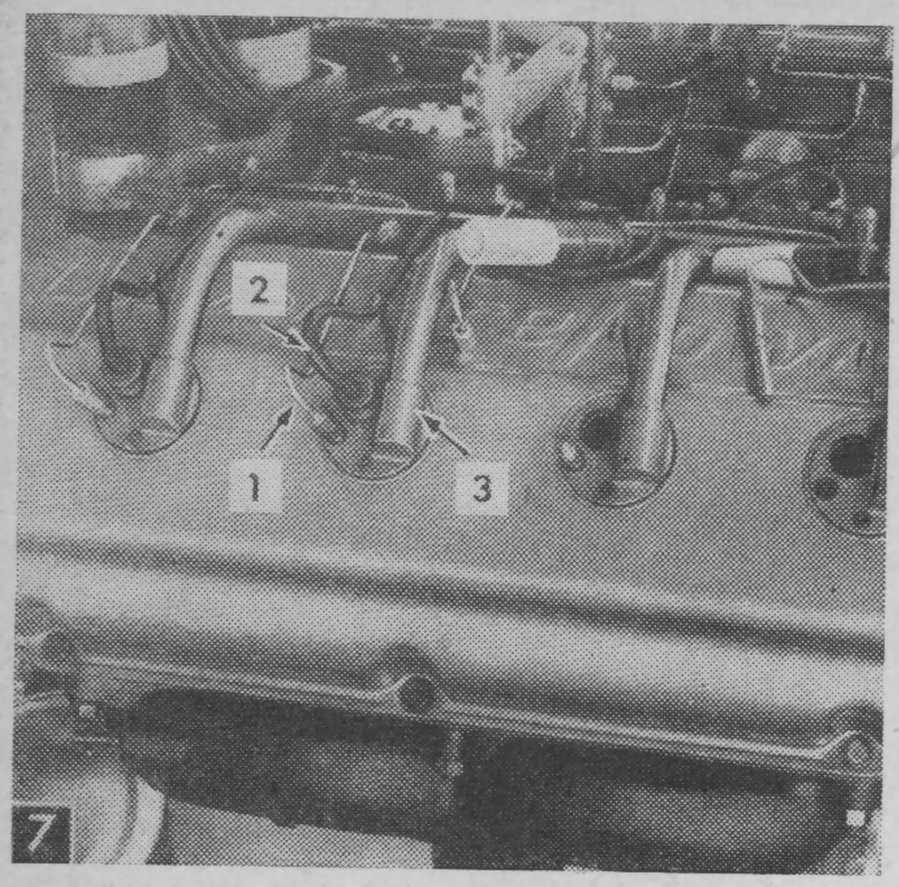
A. Anywhere from 10 to 20% of the fuel goes unburnt. Of the total fuel and gases exhausted, from 5 to 7% have been tabbed



Graph shows specific fuel consumption for RAM Straticharge engine at three speeds. Note that over a substantial part of the graph, fuel consumption is less than half a pound per hour per horsepower. Comments Dr. A. L. London of Stanford University's mechanical engineering lab: This is "all the more remarkable when it is noted that the compression ratio is only 7.7."



Graph shows that from 60 to almost 100-*hp*, hydrocarbon exhaust output is less than 1% of total exhaust gases. Only at low horsepower does Straticharge's hydrocarbon emission even approach that of the average engine's 5 to 7%. Even then, it is at least 1% less. Inventor Heintz's aim is to achieve laboratory results (as low as ⅓ of 1%) in on-the-road operation.



Close-up view of Straticharged 1956 Chrysler New Yorker engine. It can accelerate from 0-60 *mph* in 12 seconds, compared to 10½ seconds for conventional 1956 V-8 Chrysler. Note that two spark plug covers (white cylinders) and their wiring have been removed from the pre-combustion chambers. Running to each chamber are: (1) Fuel line to pre-combustion air-fuel intake; (2) Wiring for spark plug and (3) Air line to air-fuel intake.

"unburnt hydrocarbons"—the irritants that contribute to smog.

Q. You talk about a "Straticharge." What do you mean?

A. That refers to the stratification of fuel and air in the cup—the pre-combustion chamber. If it weren't for stratification, you could not use low-octane, no-lead fuels. Or fuels which won't spark-ignite without considerable air-mixing. But in the little chamber most of them do ignite because fuel and air are stratified. The layer in contact with the plug, for example, is pretty well mixed with air and is lean enough to fire. By contrast, the fuel down near the cup's bottom is very rich, almost pure fuel.

Q. Then the near-plug stratum—the one that's well air-mixed — ignites, acting as a kind of ram that ignites and explodes the fuel charge into the main cylinder?

A. That's the significance of stratification, yes.

Q. You've said that the Straticharged engine doesn't build up carbon in its cylinders and isn't troubled by leading.

A. Well, there'd be no leading if the fuel you used didn't contain lead.

Q. But suppose it did contain some lead?

A. Still there'd be no problem. It's *metallic* lead that builds up slightly in a carbureted engine's cylinders because of a lack of oxygen during combustion. In the Straticharged cylinder there is oxygen to spare. So you get only lead *oxide*—a kind of dust that simply blows out the exhaust.

Q. And there's no carbon build-up either?

A. No carbon in the main cylinder, or if there is any, it quickly erodes away.

Q. But there is some carbon in the cup?

A. Yes, quite a bit forms there. But it doesn't linger long. It's exploded, right along with the fuel, into the main cylinder. Carbon in the small chamber is actually an advantage, for it acts like a wick, sopping up liquid fuel. The engine runs better after carbon has built up in the cup.

Q. Dirty fuel doesn't foul the plugs?

A. You'd think it would, but the fact is it doesn't. It doesn't because the plug never fires in a rich mixture. And it is a rich mixture that fouls plugs.

Q. Maintenance, then, should be reduced appreciably?

A. Yes. Also, there is no oil dilution because liquid fuel never washes the main cylinders. Even when fuel is injected directly into a cylinder's air intake during high acceleration, it vaporizes as it enters because there is considerable heat of compression.

Q. Efficiency-wise, where does the RAM Straticharged engine lie in comparison with the gasoline engine and the diesel?

A. About midway. It is far more efficient than the gasoline engine but slightly less efficient than the diesel.

Q. There are other compromises?

A. Yes. For example, Straticharged combustion is noisier than a gasoline engine's, particularly when idling or at low speeds. But it's not nearly as noisy as a diesel.

Q. Dr. A. L. London reported fuel economies with your Straticharged engine ranging up to 30% over the conventional carbureted engine, I understand.

A. Well, he indicated such economies were possible. To realize upwards of 30% fuel economy, the average car owner would have to burn really cheap fuel—casing-head gasoline, for example. The stuff that comes raw out of the oil well.

Q. But at present, service stations don't pump fuel like that.

A. No, they don't. The average motorist can get diesel oil, but not the less-expensive casing-head gasoline or jet fuel. But service stations will pump the cheaper fuels someday, if demand makes it worthwhile.

Q. Still, couldn't the average car owner save considerable money—maybe 5 to 8¢ a gallon—by Straticharging?

A. He could. I've been saving that much, fueling a Chrysler I drive that's been Straticharged for more than two years.

Q. Could the average outboard motor be Straticharged?

A. Yes. And it would use about half as much fuel as a carbureted outboard—yet put out the power of one a third to a fourth larger in size.

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Q. Would conversion of a present outboard motor be simple?

A. That depends on the motor. You would need some means of actuating the fuel-air valves, both in the small chamber and in the main cylinder. In your car, the rocker arms provide that, but not in the usual outboard. And for really spectacular results in the outboard, you'd rig the motor with a blower to supercharge the pre-combustion chamber. A 100-*hp* Stratícharged motor is certainly not impossible.

Q. What if Stratícharge were designed into an outboard motor, built in by the manufacturer?

A. You could figure on a far lighter engine. About a third less weight for the same horsepower.

Q. Can we tell car owners when they can buy a Stratícharge conversion kit?

A. Not just yet. We're still in the testing stage, still making improvements. Especially in further reducing hydrocarbons exhausted from the engine. In the Stratícharged engine's usual operational range only about 1½% of what comes out of the exhaust are unburnt hydrocarbons. This compares to 5 to 7% in the average gasoline engine. But in the lab we've achieved nearly the results you get with a catalytic device—only 3/10 of 1% hydrocarbons. If we can achieve this on the road, we may be able to hand motorists a kind of bonus—smog-free operation without addition of mufflers or filtering devices, the kind that some communities may shortly require for all car engines.

Q. Could Stratícharge be built right into Detroit's new car engines—and served up to the public at no extra cost?

A. Yes. The parts thrown away—the carburetor, for one—would balance out the cost of the pre-cumbustion chambers. And production of the chambers, the only really essential add-on part, should be a fairly easy job.

Thank you, Mr. Heintz.

Free-Form "Tree House" for Kids

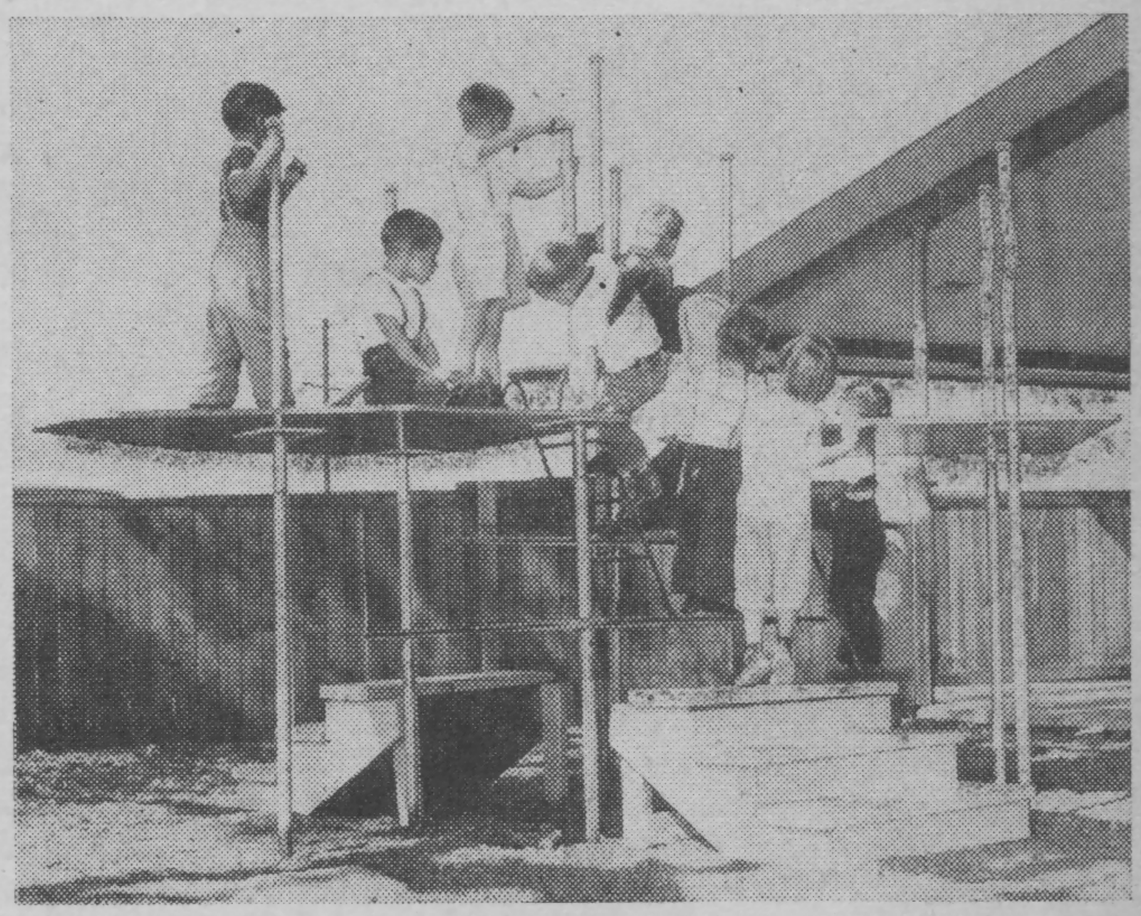
TWO men can build this climbing apparatus in a day, but it might take them a lot longer to decide what to name it.

Youngsters at the nursery school in Redwood City, Calif.—where this one is in use—call it their "tree house."

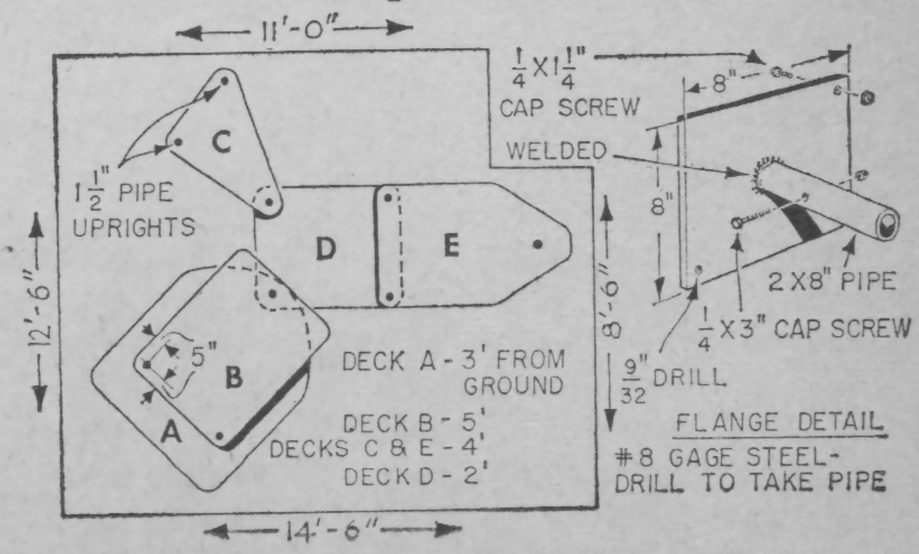
A dozen children at a time can have fun on its five free-form decks. The decks are built from ¾-in. exterior grade fir plywood, finished top and bottom with spar varnish. Sprinkling sand on the varnish before it dries makes for more secure footing.

The flanges supporting the decks are 8-in. square, made of 8-gage steel, and 15 are used (see drawing). They are welded to 8-in.-long sleeves made from 2-in. standard pipe, which is big enough to slide over the 1½-in. water pipe uprights, capped on top. The pipes are secured to the flanges by cap screws passing through the sleeves, and the flanges are screwed to the decks. Each of the uprights rests in an 18-in.-long sleeve set in a concrete footing.

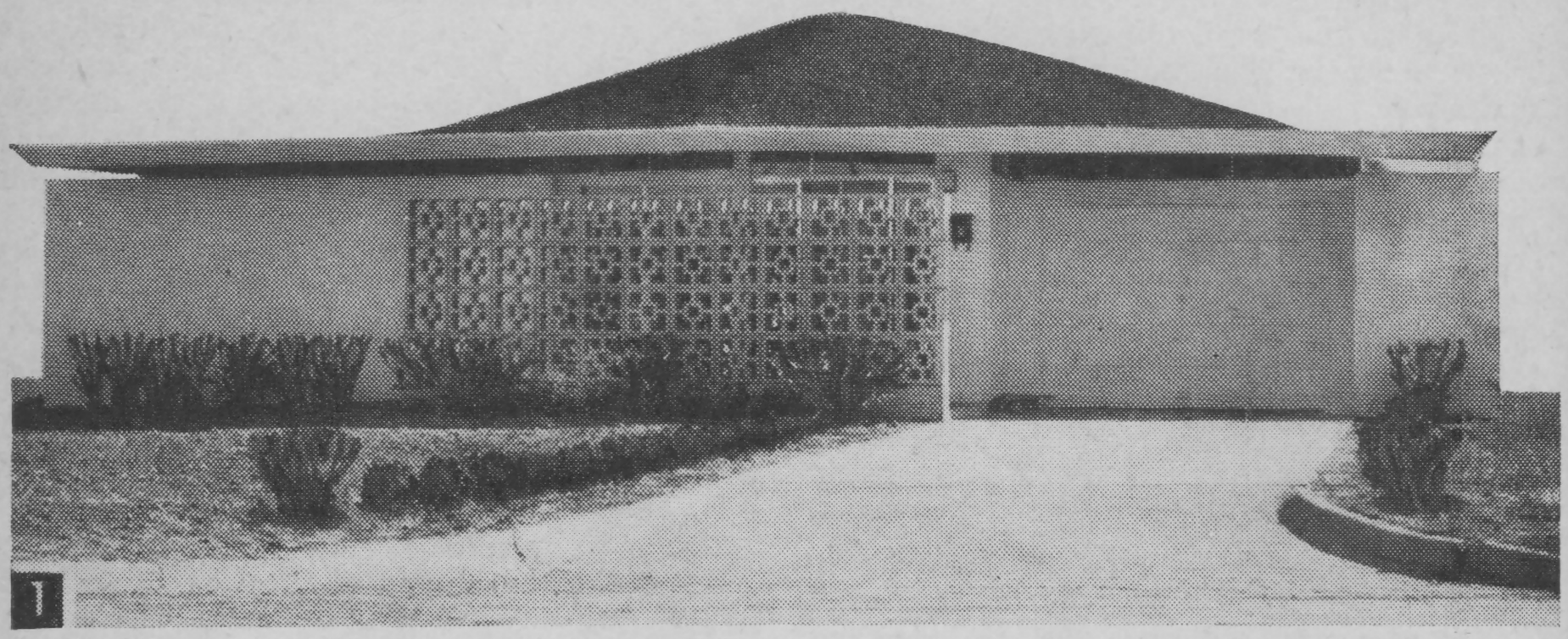
For the tiny tots who may have trouble reaching the lowest deck, make a set of steps from 2-in. lumber. And for clambering from one deck to another, short steel ladders with rubber tips are available at many hardware stores. You can also add a great deal to the children's fun by setting up a slide attached to an upper deck.—BERT GOLDRATH.



Drawing shows size and shape of the five decks. Decks A and B are made from one of the large sheets of plywood. C and D are made from the other, while E is made from the smaller sheet. Inset shows flange detail.



Concrete "Umbrella" Homes Slash Maintenance Costs



This house is built entirely of concrete. Because it is, it has almost no upkeep cost and will last for about 500 years. Its roof is supported only by a center column; thus, its pre-cast, non-bearing walls are—in effect—nothing but beams resting on piers.

Here's how an Oklahoma architect and a concrete builder are teaming up on "lifetime" houses with most upkeep expense "built out"

By W. U. and JAN McCOY

A STARTLING new type of house construction, all-concrete and with an "umbrella" roof, provides a home that is almost maintenance-free, has an unbelievably long lifetime—and costs less.

Six of the homes, designed by Oklahoma City architect R. Duane Conner, have been constructed by builder Harold Hessel and have sold much faster than Hessel's conventional houses in the same area.

Long life? The Federal Housing Administration gives the homes its maximum dwelling life-rating of 50 years. One appraiser, pressed for an estimate of the houses' true lifetime (one not limited by the F. H. A.'s categories), came up with a figure of 485 years.

Maintenance? Nothing in the basic structure is susceptible to termites, rot, sagging or deterioration.

Fire and wind damage? Since an all-concrete house can't burn and a 40-ton roof isn't likely to blow away, the quoted insurance rate is only $10 a year—about one-twelfth that of comparable conventional houses in the same area. This also reduces considerably the monthly time payments.

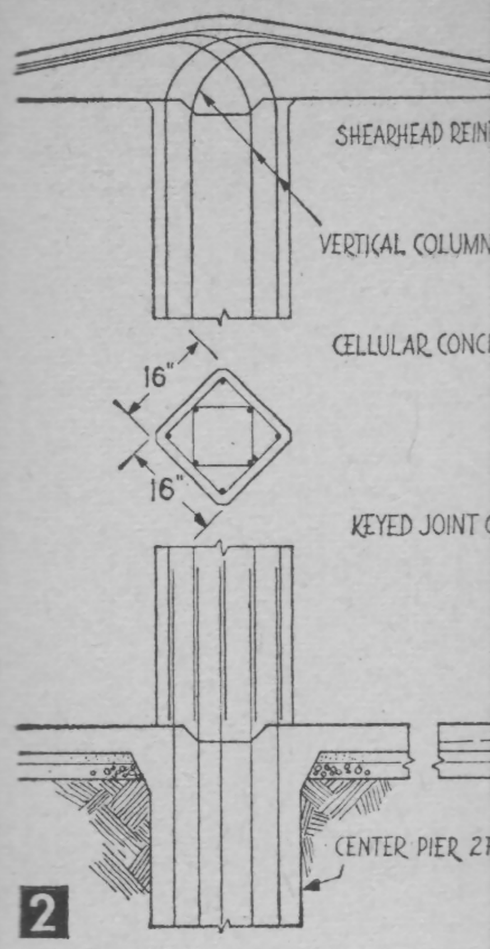
Not only are savings great in the long run, but costs are cut at every step in construction. The builder uses one crew to pour piers, the floor slab and the roof structure and to raise the pre-cast foamed concrete walls. Many building trades, materials and costly delays are thus eliminated.

Two Different Types of all-concrete houses have been built by Hessel so far: A house with an "umbrella" roof, supported by a center column only, and a house with its roof supported at the four corners. Let's examine the construction of the more revolutionary and intriguing center-support house.

In brief, it is this: Supporting piers are dug and poured. The slab floor and the center column are poured, and then the roof itself is framed and poured. Finally, the pre-cast walls are raised into place. (The first homes had poured-on-the-site walls, but Conner has found the newer, pre-cast ones to be more economical and to have better insulating qualities.)

This new approach to home-building is made possible primarily by the paraboloid shell concrete roof. Architect Conner feels it may be the most economical structural form in existence.

Because of the roof's double curvature,



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forces in each direction it cannot bend, and only crete and steel is need stability.

The roof's only suppo by 16-in. concrete colum ter of the house. The co concrete pier, 2 ft. in dia column are tied together eight vertical steel rein each corner and the ce the column. Steel ties a bars upright, and the co with lumber and poure

The roof—despite its with straight lumber. E sign is needed, but Cor easily laid out.

Framing the Roof. Fir by 4s is laid, supported thus created is divided into quadrants (see Fig. 3) by other 4 by 4s which rest on top of the center column. The height of this framework varies from 7 ft. —where the roof dips nearest the exterior walls—to 11 ft., 6 in. at the column.

Let's look at the framing within just one of the quadrants, since it is identical for all four. A 4 by 4 stringer is used to divide the quadrant in half, then others are placed parallel to it to divide the quadrant

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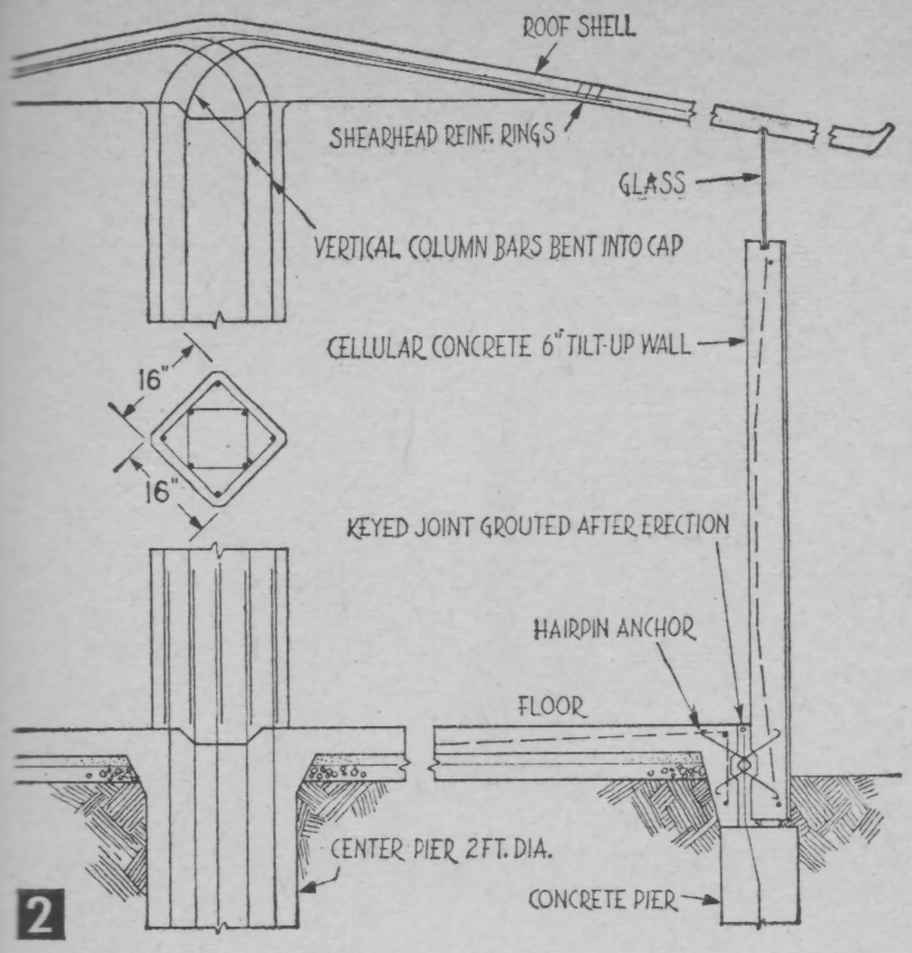

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forces in each direction are balanced so that it cannot bend, and only a minimum of concrete and steel is needed for strength and stability.

The roof's only support is the vertical, 16 by 16-in. concrete column located in the center of the house. The column itself rests on a concrete pier, 2 ft. in diameter. The pier and column are tied together by an indent and by eight vertical steel reinforcing bars, one in each corner and the center of each side of the column. Steel ties are used to hold these bars upright, and the column is then formed with lumber and poured.

The roof—despite its curvature—is framed with straight lumber. Extremely careful design is needed, but Conner says the roof is easily laid out.

Framing the Roof. First, a perimeter of 4 by 4s is laid, supported by jacks. The square thus created is divided into quadrants (see Fig. 3) by other 4 by 4s which rest on top of the center column. The height of this framework varies from 7 ft. —where the roof dips nearest the exterior walls—to 11 ft., 6 in. at the column.

Let's look at the framing within just one of the quadrants, since it is identical for all four. A 4 by 4 stringer is used to divide the quadrant in half, then others are placed parallel to it to divide the quadrant into eight sections. (At the narrower end of the quadrangle, of course, the stringers are closer together.) Then more stringers are run across in the other direction. Some 1 x 8s are laid across these, and then a full plywood surface is laid.

Since three corners of each quadrant are held flat and one is raised, curvature results —with parabolic arches going in one direction and hyperbolic curves in the other.

After this pouring surface is completed, a square section around the column is cut out. This section is then framed and supported by jacks. A flat piece of plyboard is cut and fitted around the column for a pouring surface. This allows steel to come out of the top of the column and bend over for additional reinforcement.

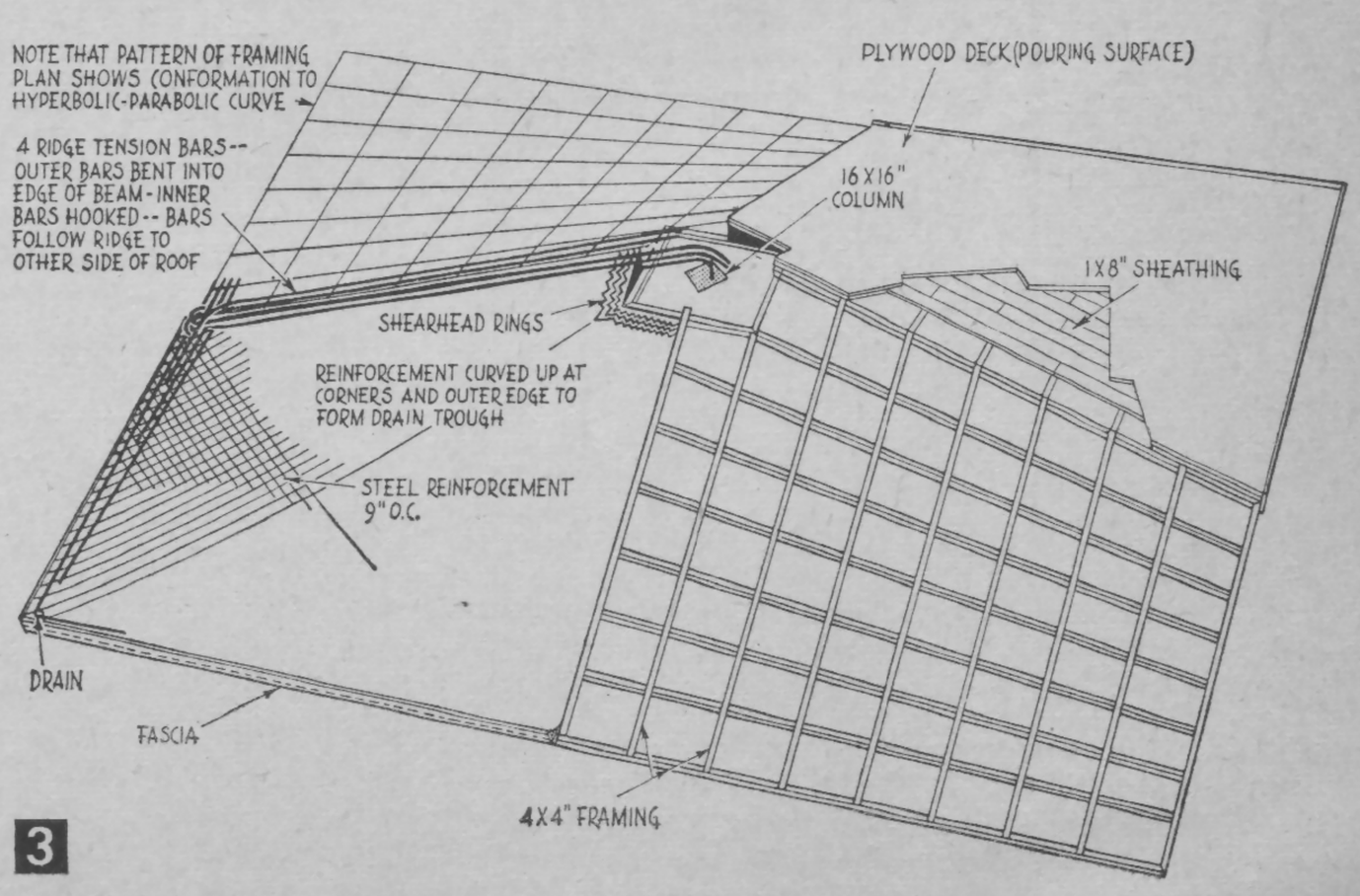
Steel reinforcing is then arranged on the entire roof. Steel bars are criss-crossed diagonally across the plywood. Four ridge tension bars stretch across the roof and others run around the perimeter.

At the perimeter, all the bars are bent up so that when the roof is poured, it will have a slight upturn at the overhang. The upturn serves as a gravel guard when built-up roofing is used and prevents water runoff during rainstorms. Instead, water runs out through a drain built in at each corner.

After all the steel has been placed and tied in, lightweight *Haydite* concrete is poured by crane. The roof is 3 in. thick, although at the center column—where all the steel crosses over—the concrete is poured 1 ft. thick.

Pouring finished, the roof is cured by placing a water sprinkler on top of the house and letting it run for two or three days. After seven days, the forms are removed, and the roof is supported by the column alone.

Built-up roofing can be used, but Conner says plastic resin coatings are just as permanent and offer better savings. Structurally,



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a ¾-in. standard pipe at the center of each exterior wall, joining the top of the wall and the roof, stabilizes the roof against uplift by the wind. The gaps between the walls and the roof are spanned by glass.

Flexible Interiors. Arrangement of the interior partitions is completely flexible, since they are non-bearing. For rooms where privacy is needed, glass is installed from the top of the pre-cast *Betocel* partition walls to the ceiling. Tops of the other walls are left open, adding to the feeling of space and light these houses achieve (see Fig 5).

How long does this on-site work take? Digging and pouring the piers is a one-day job. The floor slab is formed one day and poured the next. Raising the pre-cast walls into place and joining them is another one-day job, plus curing time. Five men form the roof, arrange the steel and have it ready to pour in two or three days. The roof is poured in two hours, and forms are removed a week later.

The only slow part of the operation is the one-week wait for the roof to cure. Hessel plans to try a steam cure. Using a steampot and perforated hoses, he thinks he can pour the roof one day and take the shoring out next morning.

Although a conventional house may go up a bit faster *at first,* since rough-in framing is a speed operation, the all-concrete house will be ready for occupancy sooner.

The concrete house with the corner-supported roof is built in much the same way,

Here, the roof-support column is left in sight behind the sofa, serving also as part of the hallway screen. In some houses, the column is hidden from view in a closet section. Note the feeling of spaciousness achieved by the high, sloping roof and the wall at right, which does not reach to the roof.

with two exceptions: At each of the corners, deep piers are needed, and the center column is of course eliminated.

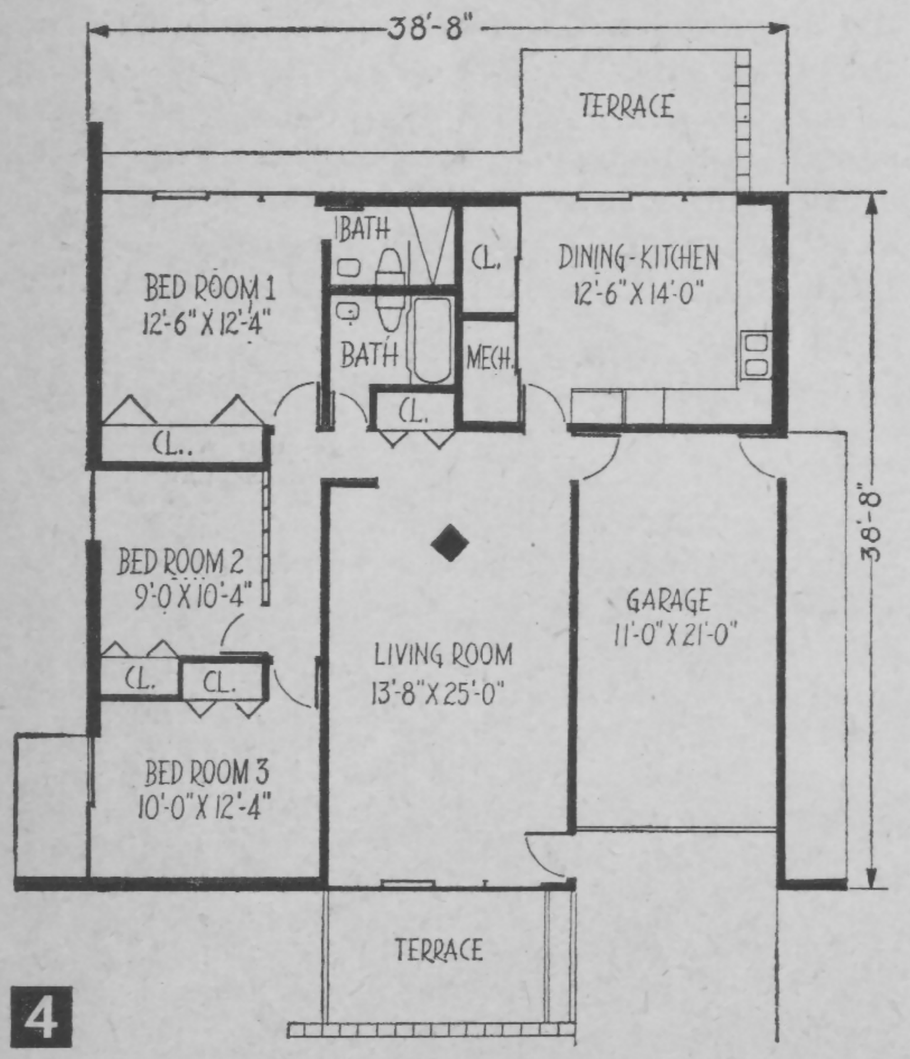
Heating and cooling costs are expected to be less than in conventional houses, although enough time has not elapsed for adequate comparisons. On first bills, homeowners believed costs tended to be less, and they found the warmth to be soft and evenly distributed. No moisture problems have been found.

What's the Cost? Prices of the all-concrete home, including lot, have been running between $14,500 and $15,000 (as the builder gains more experience in the new technique, it's hoped this will be reduced). Prices compare favorably to those of comparable conventional houses in the area, which sell for from $14,000 to $18,000 or more And the paraboloid houses are offered complete with built-in electric oven and range, attractive kitchen counters and cabinets and sliding glass doors to the fence-enclosed patio areas —extras found toward the upper price range of other houses.

One disadvantage of this type of house is that it cannot be built just anywhere. The site must be in a town or city, or otherwise near enough to capable, experienced concrete builders.

It is not a home for someone who has a strong preference for traditional designs such as colonial or Cape Cod. It is not a home to be remodeled or expanded.

It *is* a permanent structure for buyers who know exactly what they want and can project their needs into the future.



This is a typical floor plan of the "umbrella" roof house shown in Fig. 1. The F. H. A. appraisal is $15,750, but it has been selling for between $14,500 and $15,000. Note the location of the roof-support column at the rear of the living room.

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Each frame of the thermopla pared to a paper clip—is less t wide. The image is recorded in ripples, but when light hits th image can be

ONE day soon you stant" home mo viewed as soon a thanks to a new, expe system called TPR.

TPR—thermoplastic re been imaginatively likened to the stone tablets on which the ancients chiseled hieroglyphics. The new system, though, replaces the stone with a thin transparent film, and the carving tool is an electron beam instead of a chisel.

TPR combines the processing speed and much of the versatility of magnetic recording with the storage capacity of photography —and offers some advantages over both,

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New Thermoplastic Tape For INSTANT HOME MOVIES

Each frame of the thermoplastic record—shown compared to a paper clip—is less than a quarter of an inch wide. The image is recorded in the form of microscopic ripples, but when light hits the film at an angle, the image can be seen.

ONE day soon you may be taking "instant" home movies—ready to be viewed as soon as they are taken—thanks to a new, experimental recording system called TPR.

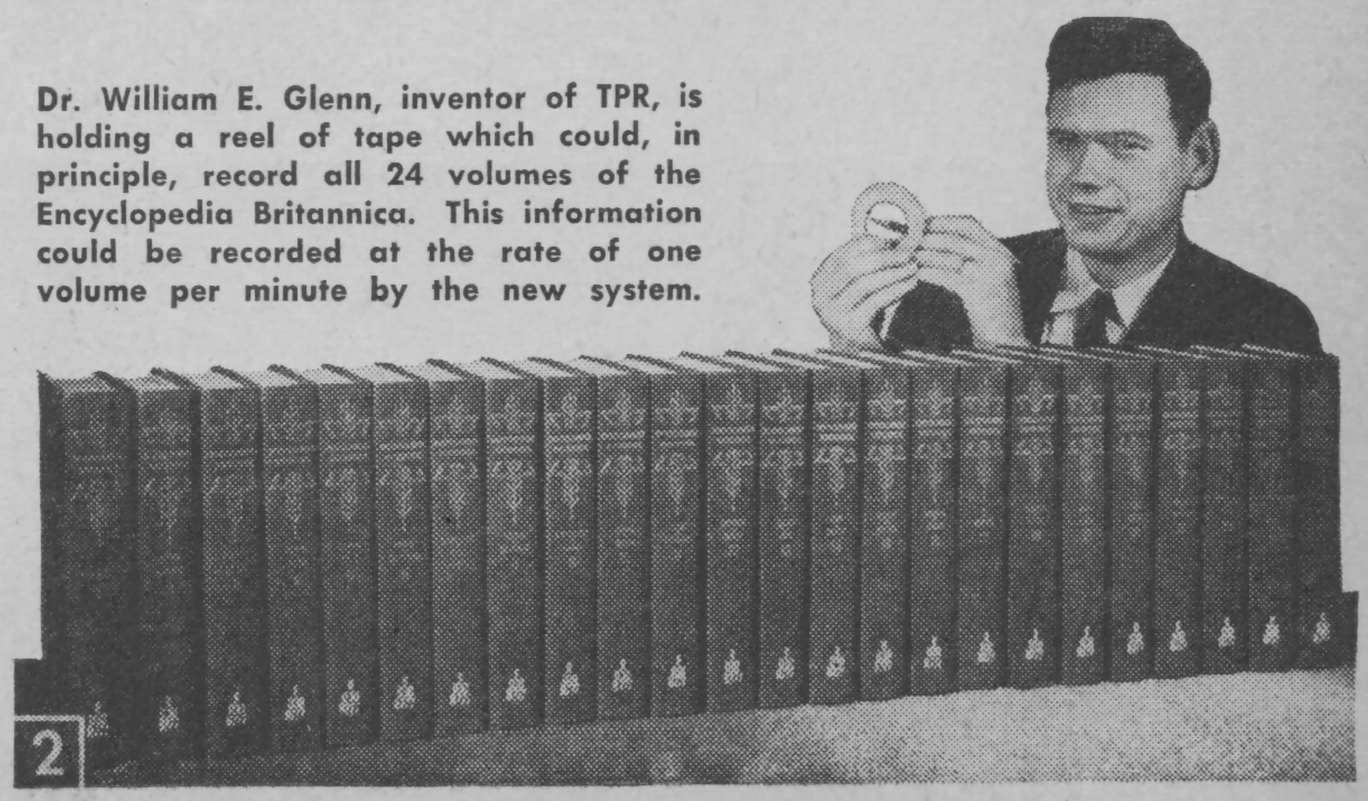
TPR—thermoplastic recording in full—has been imaginatively likened to the stone tablets on which the ancients chiseled hieroglyphics. The new system, though, replaces the stone with a thin transparent film, and the carving tool is an electron beam instead of a chisel.

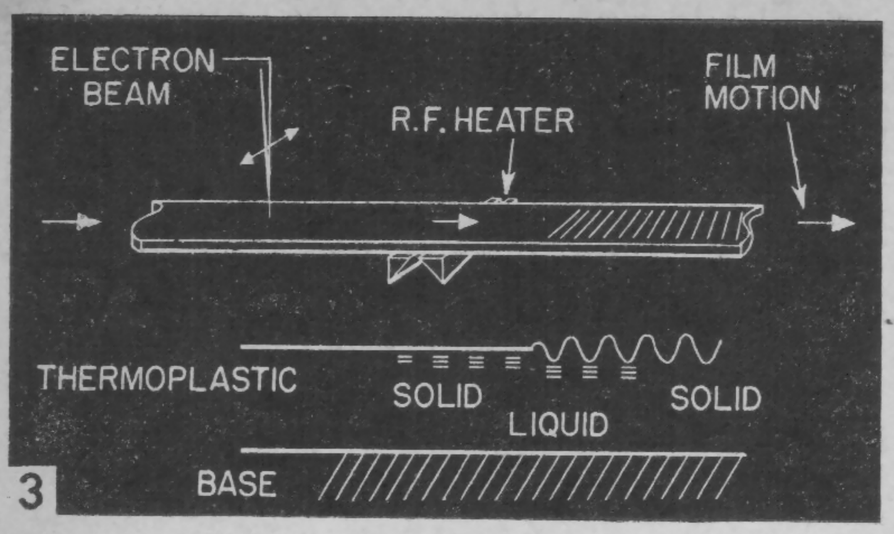
TPR combines the processing speed and much of the versatility of magnetic recording with the storage capacity of photography—and offers some advantages over both, according to its developers at General Electric Research Laboratory, Schenectady, N. Y. It also has some drawbacks.

Like photography, TPR has the advantage of almost instantaneous recording and can produce pictures in color or black and white, but it does not require chemical processing.

It can concentrate 100 times as much information in a given space as can magnetic recording and has the potential for still greater concentration, according to Dr. Guy Suits, G. E. vice president and director of research (see Fig. 2). For TV use, the new system produces an image that can be discerned, frame by frame, which greatly simplifies editing. It also can be erased and re-used indefinitely, unlike magnetic tape which has a limited lifetime; and instead of the hour it now takes to copy an hour of video tape, TPR copies could be quickly "pressed" from the master tape, ending the time-wasting "1 to 1" conventional ratio.

Dr. William E. Glenn, inventor of TPR, is holding a reel of tape which could, in principle, record all 24 volumes of the Encyclopedia Britannica. This information could be recorded at the rate of one volume per minute by the new system.





Among its disadvantages:

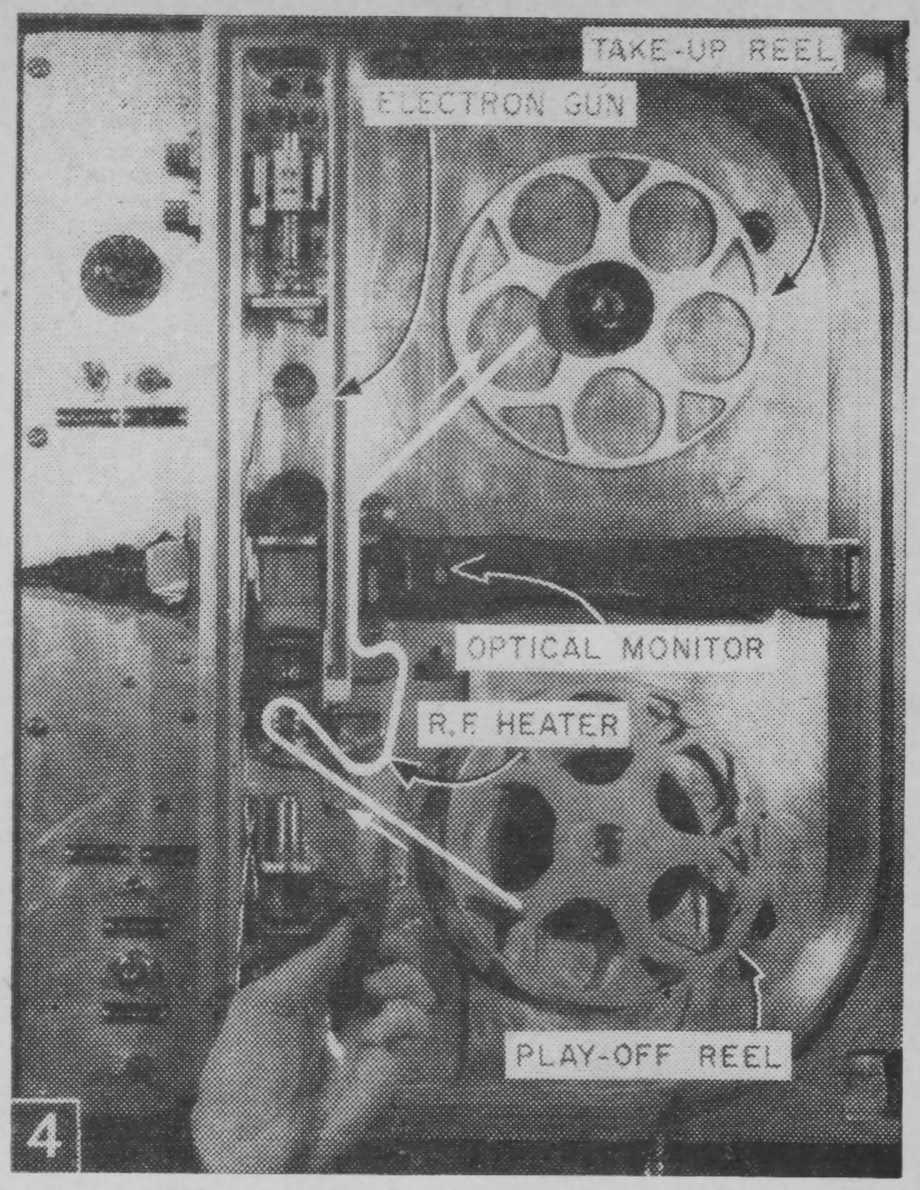
• Some video engineers believe that since TPR is a film-like process, film fragility will cause some problems and the new system will not provide the life-like reproduction achieved by video tape.

• The need for a high vacuum chamber in the recording process could keep it from some applications.

Besides the obvious uses of TPR—currently being handled by photography and magnetic tape—some non-classified military applications are being studied. Because of TPR's large bandwidth (well in excess of video tape's), high-density recording and direct read-out capabilities, it might find uses in such areas as radar and infrared detection, electronic countermeasures, missile guidance and military communication.

How Does TPR Work? The input of a TPR recorder is electrical, similar to that of a magnetic tape recorder. Its output is an image, like that of photographic film, which can be changed to an electrical output by standard methods.

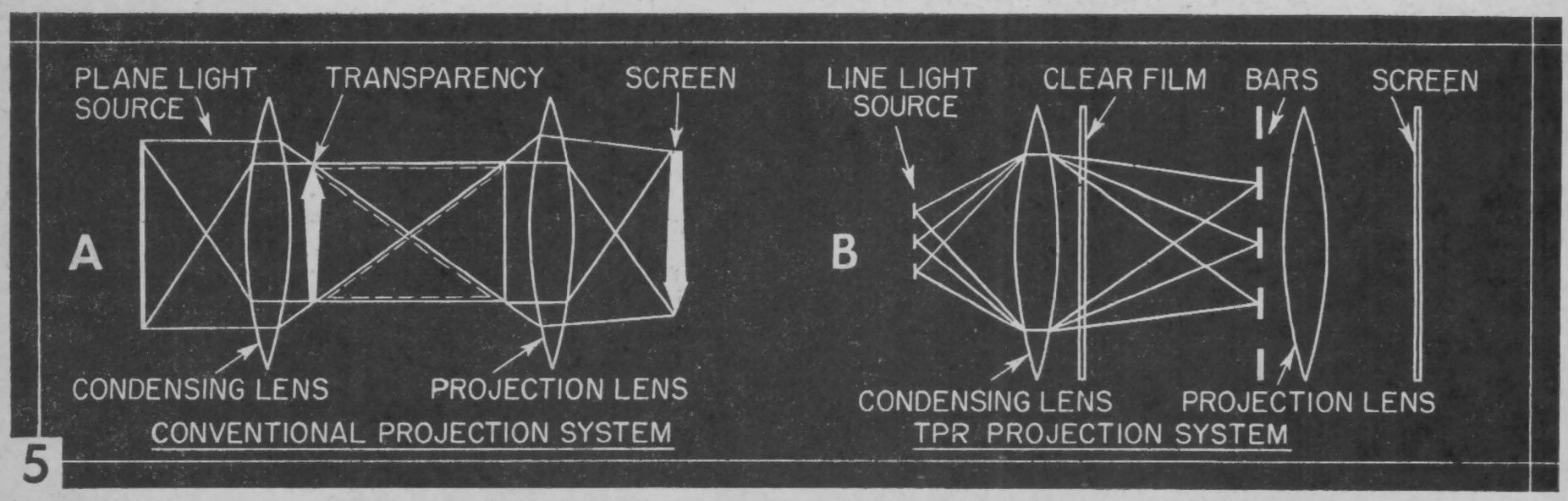
Figure 3 shows the recording process and a cross-section of the TPR tape. The tape is the size of 16 *mm* film. Large-size recordings use half the width, and film speed is 10 in. per second. For TV use, speed would be 5 in. per second, and the recorder track .1 in. wide. The film's heat-resistant base is much like that of standard moving picture film. Above it is a transparent, positively-charged



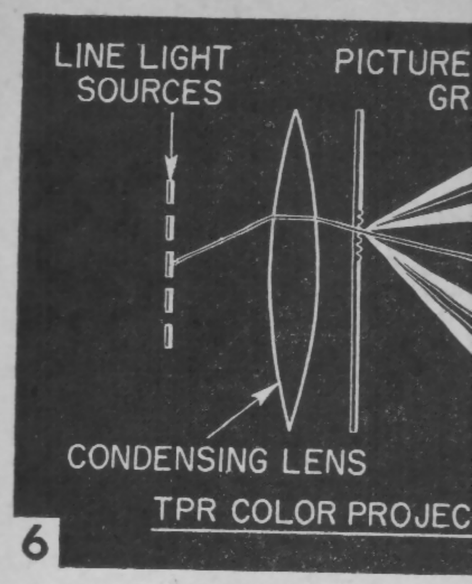
The TPR tape moves from the play-off reel, past an electron gun, a heating unit and an optical monitor, to the take-up reel. The entire front of the recorder has a transparent plastic cover with a gasket seal. When the door is closed, a pushbutton starts a pump which creates a vacuum in one minute. Another button destroys the vacuum.

coating, and on top of this is a coating of thermoplastic material which melts at a fairly low temperature.

As it moves through the recorder (see Fig. 4), the surface of the thermoplastic is charged with an electron beam in a pattern corresponding to the pattern of ripples that is to form the image. As the film moves, a current is induced in the conducting coating, heating the film and melting the thermoplastic. The charges are attracted to the transparent conducting coating and depress the surface of the thermoplastic.



A projection system suitable for TPR is shown in 5B, with no ripples on the film. With ripples, light would pass between the bars, creating an image on the screen.



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The TPR projection
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The TPR projector,
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TPR can also be used fo
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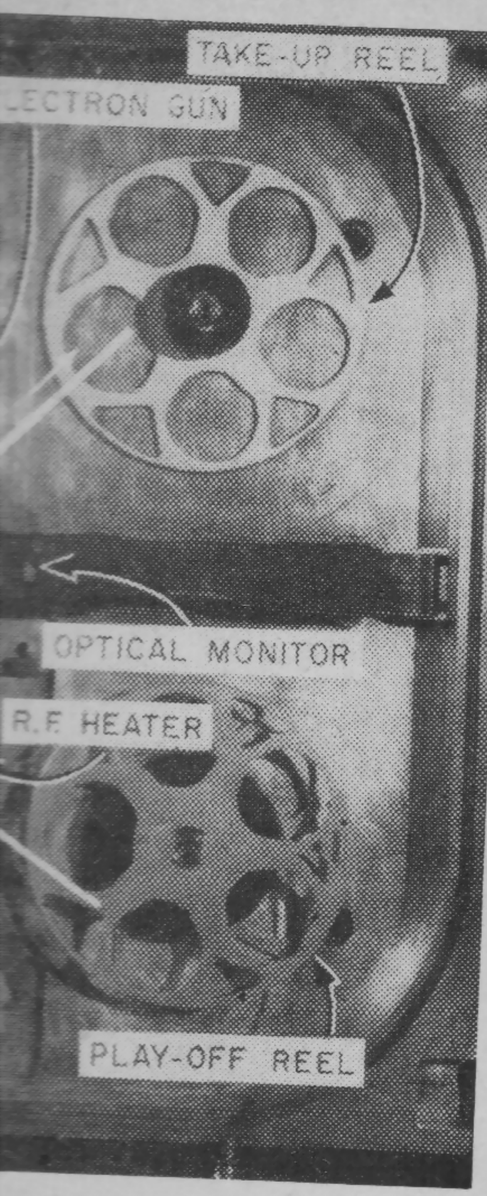

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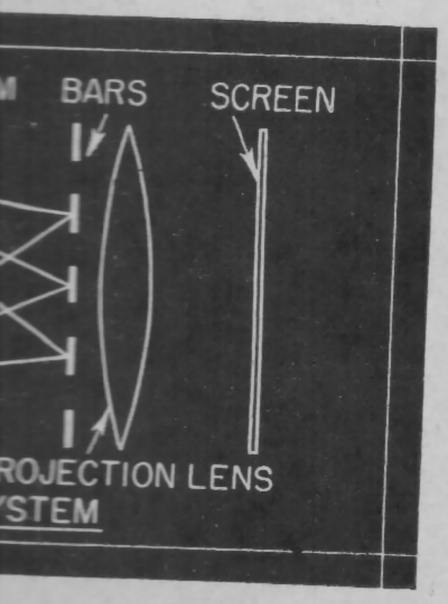
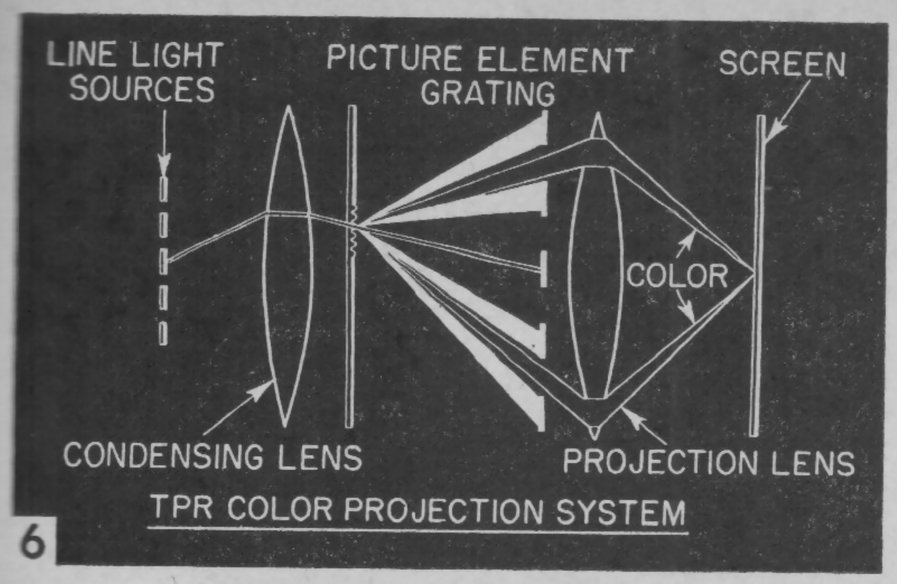


Vith ripples, light would



After the surface has been deformed by the charges, the film cools, freezing the ripple pattern in place. This all takes place in less than .01 second. To erase the information and make the film re-usable, the thermoplastic is reheated so that the charges leak away and surface tension smooths the surface back to its original shape.

Images from Ripples. A special optical system is used to accomplish the seemingly difficult job of using these ripples on the surface of the film to produce an image.

The TPR projection system is shown in Fig. 5, contrasted with a conventional projection system. The standard system has a plane light source, a condensing lens and a projection lens. The light source is imaged on the projection lens by the condensing lens, and the projection lens then images the transparency on the screen.

The TPR projector, however, sends *line* light sources through the film and images them on a set of bars in front of the projection lens—so that no light gets through to the screen.

When there are *ripples* on the surface of the film, however—as after recording—these scatter light through the bar system. In essence, the bar system acts much like a shutter, letting light pass wherever there is a ripple on the film. Wherever light does pass through the projection lens, it images the ripple on the screen as a white spot.

TPR can also be used for color (see Fig. 6). The ripples are impressed on the film so that each picture element has a set that form a tiny diffraction grating. Light diffracted by the grating forms a spectrum on each side of the central beam.

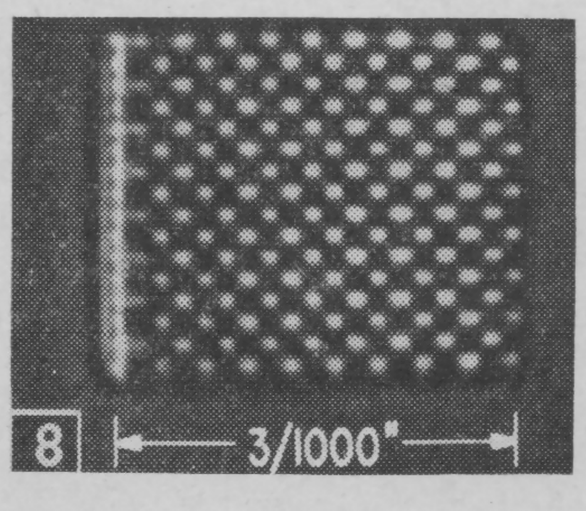
Slots in the bar system are made narrower than in the black-and-white system, so that only one color from the spectrum gets through to the projection lens, thus producing a single-color spot on the screen. To get a different color, the spacing of the grating is changed to permit a different part of the spectrum to get through. To produce a color that is the sum of two or more primary colors, two or more gratings are superimposed, each with a spacing corresponding to the desired primary color.

To record audio along with the picture, a second electron gun could be added to place a sound track on the edge of the tape. Or the gun used for the video could be modified to record both sound and picture.

General Electric so far has avoided making any predictions about when TPR will be on the market. Some TV engineers think, however, that it may be in use in from two to 10 years, depending on how much of a "crash" program gets under way.

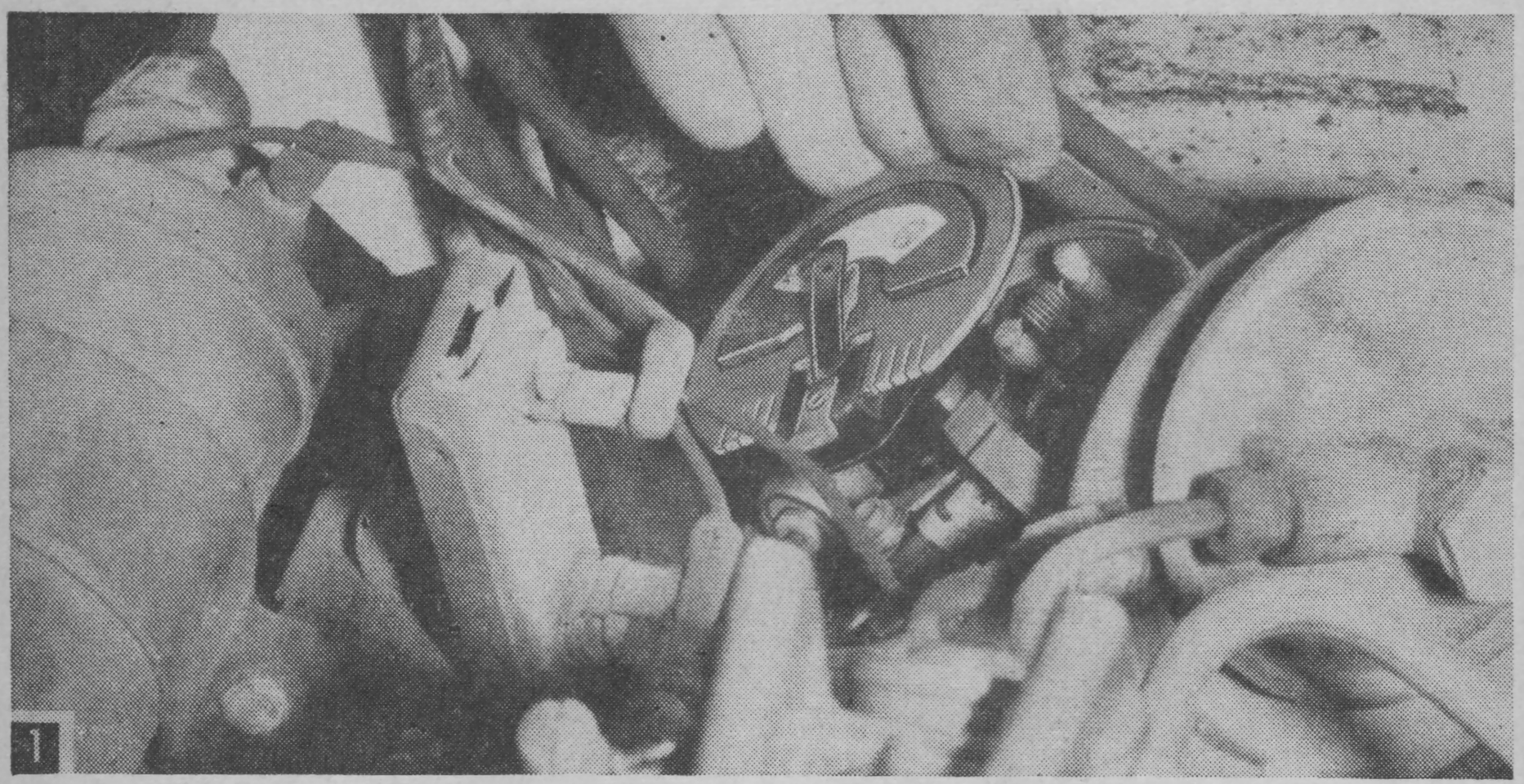
Several other companies also have been carrying out research on thermoplastic recording, but G. E. appears to have a head start. The company is expected to license the technique to other firms.

Here, Dr. Glenn operates the TPR recorder (top) to transform a TV signal into a series of minute wrinkles on the thermoplastic tape. The film is then used (bottom) to project an image. In its present stage of development, final image is still fairly crude.



This checkerboard pattern made by TPR shows how the new system could be used to record analog signals. With the binary digit system, where the light and dark squares could represent "0" and "1," it would be possible to record at the rate of 40 million "bits" of information per square inch.

Test Report on a
Solar-Volt All-Electronic Supercharger



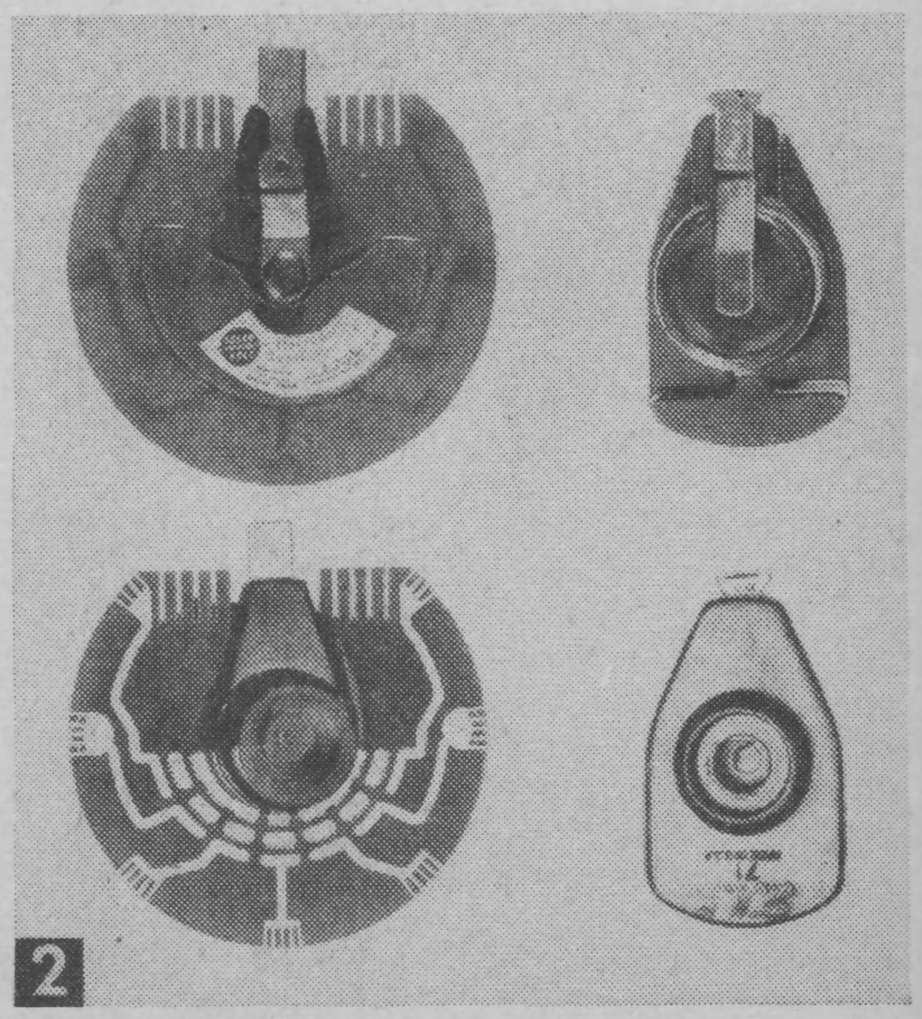
Solar-Volt All-Electronic Supercharger used in tests described, about to be installed in a distributor, in place of the regular rotor.

MANY of you readers have written us, asking for a performance report on a product called a Solar-Volt All-Electronic Supercharger.

According to the sales literature on this product, the All-Electronic Supercharger . . . "increases pulling power and acceleration." Also, "Solar-Volt precision combustion keeps spark plugs cleaner, improves overall economy . . ."

To the engineers at our regular testing facility—Professional Engineering Consultants—the All-Electronic Supercharger appears to be a rotor, also called a distributor finger or distributor, which is installed in place of the conventional rotor found in the distributor of a car. The leakage paths (Fig. 2) appear to serve as capacitances so that each plug will have a potential at the time one plug is firing. Conceivably, the gases between the electrodes of the spark plugs not firing might be ionized by the action. How this will affect combustion in these cylinders when, later, they are on their power strokes seems problematical. Note, for example, that in a 6-cylinder engine, firing is 120 crankshaft degrees apart, hence the gas in the cylinders must stay ionized for some time.

To determine how the Solar-Volt All-Electronic Supercharger which we ordered might affect car performance, the test personnel of Professional Engineering Consultants installed one in a 1956 Ford V-8 car, with 35,000 miles on it, which was in good mechanical condition. The installation in-



View of both sides of the Solar-Volt All-Electronic Supercharger (left, top and bottom) and the regular Ford rotor (right, top and bottom) used in tests.

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were as follows:

Acceleration to 60 mph Spe

Elapsed Time in Seconds	Regul Ford R
Average	11.8
Maximum	12.1
Minimum	11.7

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Fuel Economy. A seri
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Movie Cam

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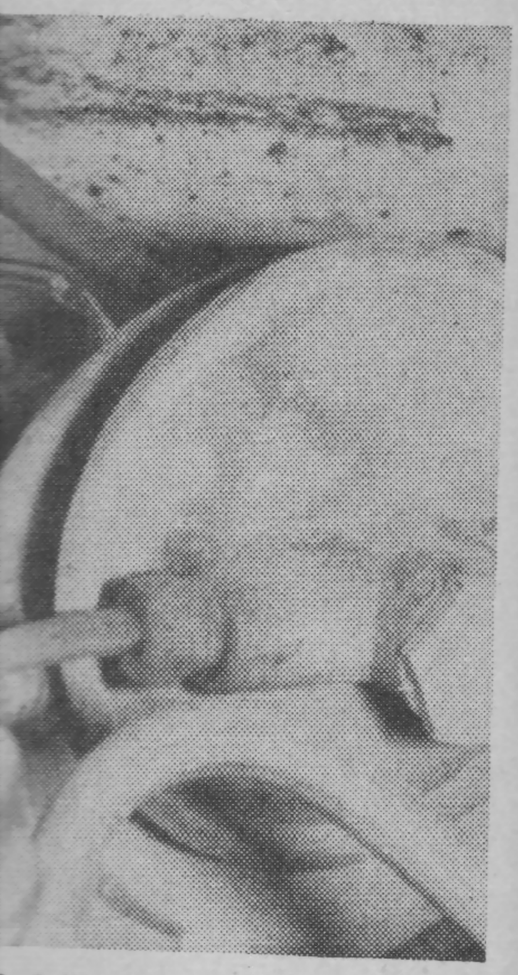

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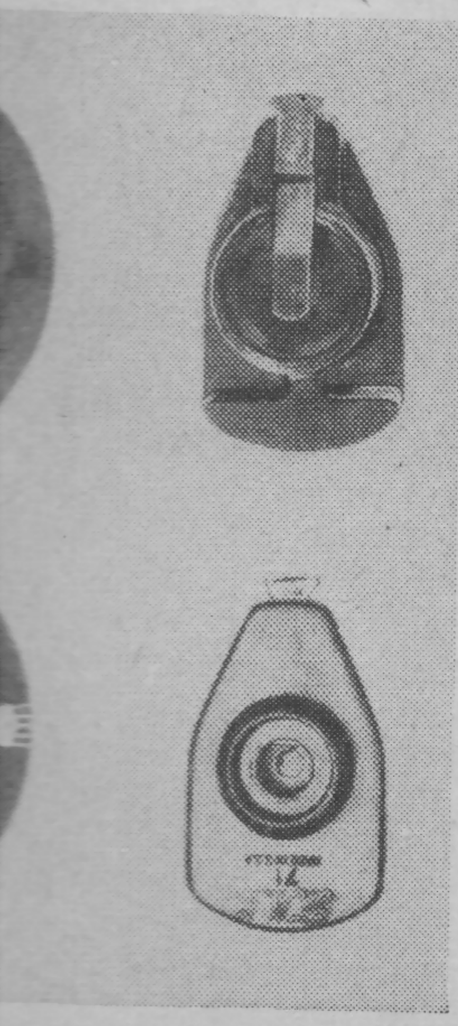


e Solar-Volt All-Electronic
d bottom) and the regular
d bottom) used in tests.

structions accompanying the product were followed carefully. A number of acceleration tests were made on several days with rotors interchanged several times during each day's testing. The results of a typical set of runs were as follows:

Acceleration to 60 mph Speedometer (55.6 mph true)

Elapsed Time in Seconds	Regular Ford Rotor	Solar-Volt All-Electronic Supercharger
Average	11.86	11.91
Maximum	12.12	12.00
Minimum	11.70	11.76

As you can see, the differences were slight, in fact, within the experimental accuracy of performing the tests.

Fuel Economy. A series of constant-speed, level-road fuel consumption tests were then run on the same car at 30 *mph* (29.6 *mph* true) and 60 *mph* (55.6 *mph* true), with the following results, which are averages of the series:

Fuel Economy (mpg) at Constant Speed

	29.6 mph	55.6 mph
Regular Ford Rotor	24.0	18.4
Solar-Volt Supercharger	24.1	18.3

The differences are, again, within the experimental accuracy of the tests. On the basis of these tests, no significant improvement in fuel economy could be attributed to the Solar-Volt All-Electronic Supercharger unit which was tested.

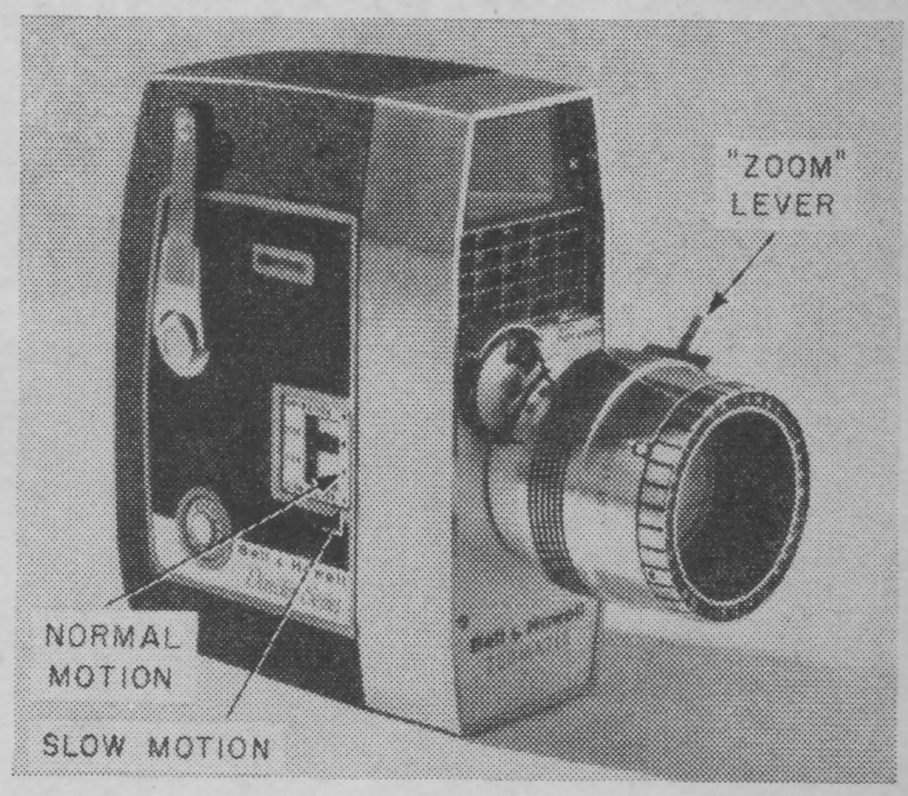
Price of the Solar-Volt All-Electronic Supercharger which we used was $9.95.

Movie Camera Has Instant Slow Motion Control

THIS new 8-*mm* movie camera is the world's first to provide instantaneous shifting from normal speed to slow motion.

For normal motion—16 frames per second—you press down the starting button (see photo). By putting more pressure on the button, you switch to slow motion (48 *fps*) without losing a split-second of action.

Developed by Bell and Howell Co., Chicago, Ill., the camera—called *Zoomatic Director*—has an f1.8 lens that can zoom from 9-*mm* to 27-*mm*. It also has an "electric eye" that automatically sets the lens opening for changes in light and speed. Price: $199.95.



Draftsmen Crawl Around on "Drawing Board"

EVER do any drafting with a drawing board big enough to crawl around on?

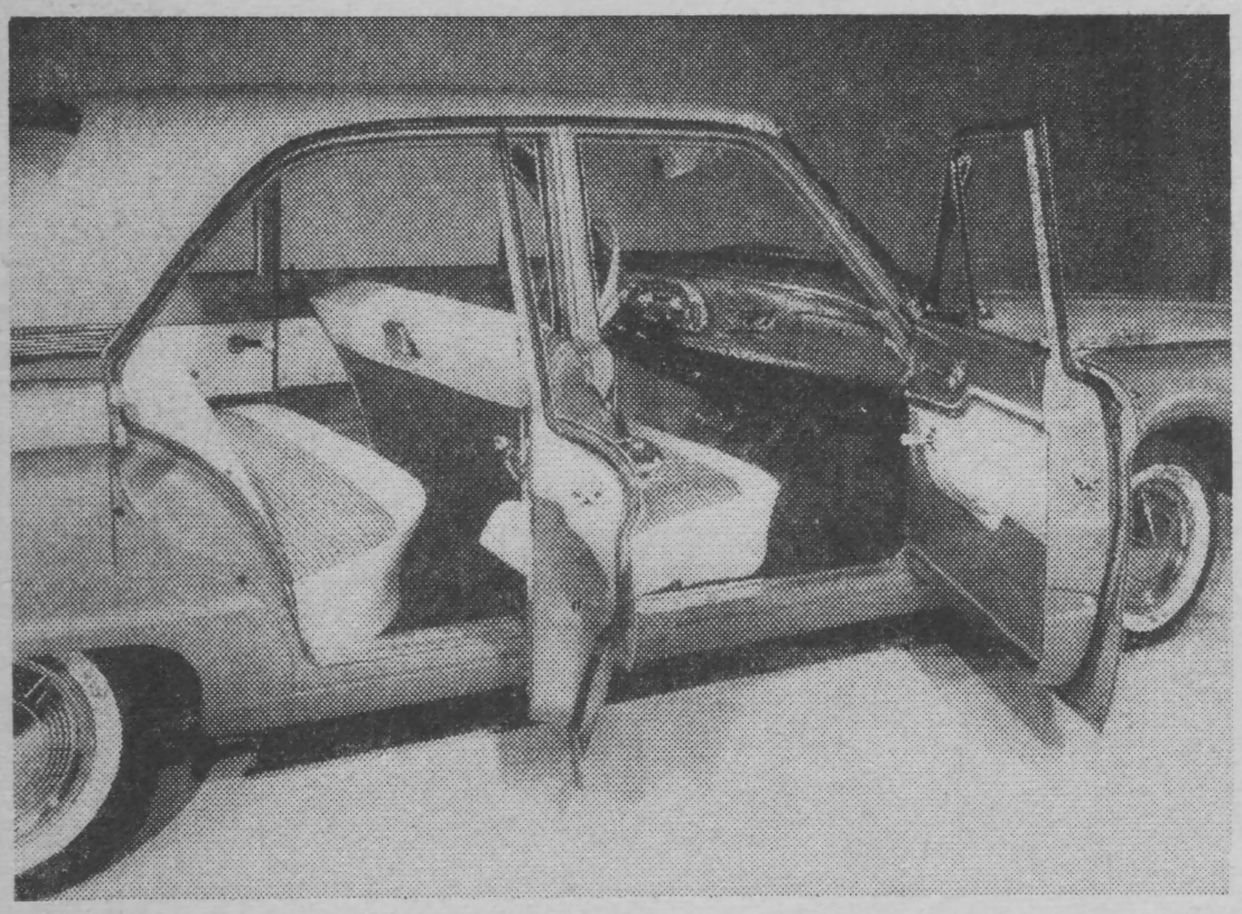
That's just what the men in the picture are doing. The "drawing board" they are kneeling on is 120 ft. long and 20 ft. wide, and it is in the layout department of Short Brothers and Harland, Belfast, Northern Ireland.

Instead of paper, the men are using metal to draw the outline of the nose and rear sections of the giant *SC 5 Britannic* turbo-prop air-freighter which will be used by Britain's Royal Air Force. From their full-scale drawings, duplicates will be lithographed on metal for the manufacture of templates.

Going into a tight corner, Comet shows a slight amount of side tilt. Note the T-Bird roofline and the horizontal grille with dual headlamps.

More New Compacts

Meet the Comet, Falcon Wagon and Corvair Coupe



Comet's front and back seats. There is a substantial driveshaft hump in front, which raises some foot problems for a center passenger.

WITH the new Comets now in dealers' showrooms, some wag is bound to pose the question:

"Is this car necessary?"

Ask the Lincoln-Mercury dealers, who are selling *it* instead of the defunct Edsel, and you probably will get a resounding "yes" for an answer.

But ask somebody, anybody else, and you are more than likely to come up with a head-scratching "let's wait and see." This is the year when Detroit is supposed to be switching to compacts and all cars are supposed to fall easily into categories. Yet Ford Motor Company says Comet isn't small, large *or* compact.

What *Is* Comet, Then? Essentially, it is a re-styled Falcon, with a longer wheelbase (Falcon's is 109½ in.; Comet's is 114), and an extra foot of length added behind the rear window. Inside dimensions of the two cars are almost identical, although in appearance Comet is far removed from Falcon. It has more of a big car look, giving no impression of being chopped off. Its overall length of 194.9 in. makes it 14 in. longer than Falcon, but still 19 in. shorter than the full-size Ford.

Structurally, Comet has a unitized body, with bolt-on fenders. The underbody structural members—including rocker panels, rear body framing and floor pan channels—are zinc-coated. Front suspension is an independent short-long arm design and rear is a conventional Hotchkiss design, both *a la* Falcon. A 3-speed manual shift synchromesh transmission is standard, with an air-cooled torque converter type automatic (similar to Fordomatic, but shorter, lighter and thinner) as an option.

Compare some basic Comet and Falcon engine specifications, and you won't find any differences at all. Both pull 90 *hp* from an in-line OHV 6, with 144.3 cu. in. displacement. Comet, however, sports a 3.56 rear axle ratio (manual or automatic transmission)—closer to Corvair's 3.55 than it is to the Falcon stick shift's 3.10—which indi
a bit peppier than Fal
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Matter of fact, Comet'
will average about 1½

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	Time in S	
	0-40 MPH	0-60 M
Comet	11.6	24.
Falcon	9.6	21.(

Driver's Observatio

Rear head room is poor fo
room and leg room good.
in back if front seat is push
a long-legged driver. Shal
Doors close with a nice sol
windshield wipers do good j
Large center hump in fron
won't feel it unless he takes
a bounce, and you'll feel it
entry to and exit from both
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Deep-dish steering wheel

**Comet's trunk is roomy, but lo
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shift's 3.10—which indicates it ought to be a bit peppier than Falcon, but slightly less economical on the fuel (see Tech Talk, p. 114). Matter of fact, Comet's engineers figure it will average about 1½*mpg* less than Falcon.

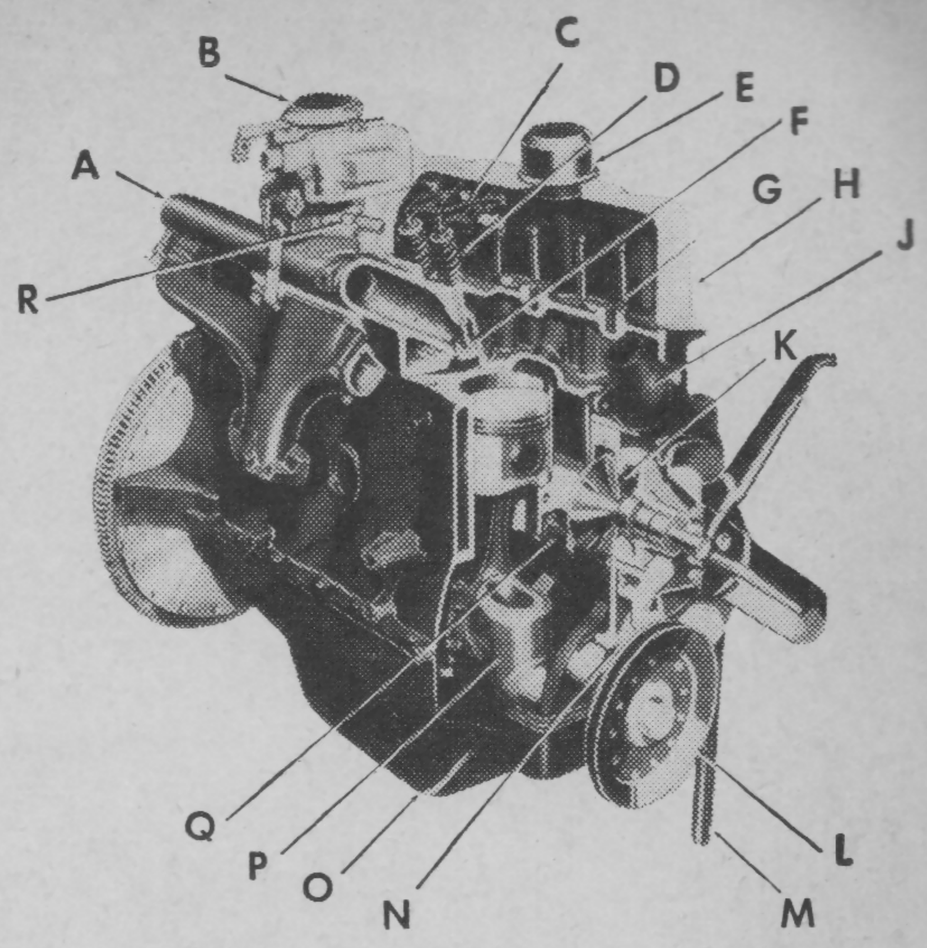
Here are some comparative acceleration times. Take them with a grain or two of salt, though, since the Falcon timings are from our Science at the Wheel report, while Comet's are based on not-quite-so-accurate stopwatch readings we made on a damp, cool and windy day at Ford's test track near Kingman, Ariz. Working to Comet's advantage was the fact that on *its* timings we used speedometer readings, which meant that when 40 *mph* was showing, true speed probably was somewhat less. Bear in mind, too, that our test Falcon had a stick shift, while the Comet we drove had an automatic transmission. Comet also is heavier; 2518 lbs., compared to Falcon's 2396. These factors, apparently, offset the Comet's speedier axle ratio:

	Time in Seconds			
	0-40 MPH	0-60 MPH	20-40 MPH	40-60 MPH
Comet	11.6	24.1	7.0	13.6
Falcon	9.6	21.0	7.2	14.0

Driver's Observations: COMET

Rear head room is poor for a 6-footer. Front head room and leg room good. Leg room not adequate in back if front seat is pushed all the way back for a long-legged driver. Shallow glove compartment. Doors close with a nice solid thud. Parallel-action windshield wipers do good job; no center blind spot. Large center hump in front, but center passenger won't feel it unless he takes a hard bounce. Less of a bounce, and you'll feel it in the back seat. Easy entry to and exit from both front and rear seats of 2-door model. Emergency brake is pull handle type. Deep-dish steering wheel comfortable to grasp.

Comet's trunk is roomy, but low in height. Note gas tank filler centered between the canted, elliptical tail lights.



Comet's 6-cylinder OHV engine. Note (A) integral intake manifold and head; (B) carburetor; (C) rocker arms; (D) valve springs; (E) engine breather cap; (F) valves; (G) push rods; (H) rocker arm cover; (J) water outlet; (K) water pump; (L) crank shaft pulley; (M) road draft tube; (N) timing chain; (O) oil pan; (P) crank shaft; (Q) cam shaft and (R) exhaust manifold.

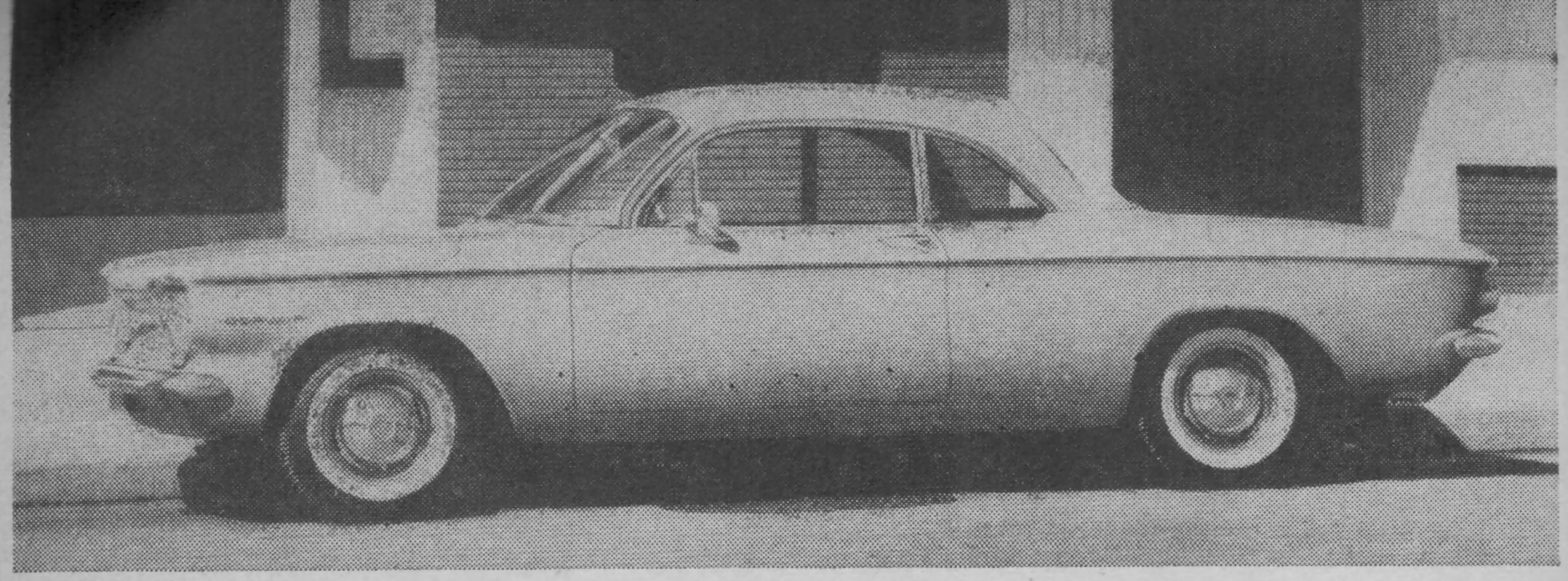
Comet's Handling is responsive enough despite its big-car overall steering ratio of 27. Steering is easy and positive. The car rides smoothly, with little vibration, on the roughest of washboards. There is very little dip on stops, and a slight amount of sway on corners. Comet recovers nicely from a hard corner, and there is no tendency for the rear end to get nervous. Overall, she seems to give a slightly more comfortable ride than Falcon, probably because of her 4½-in. longer wheelbase and slightly greater weight.

As mentioned, the extra 14 in. of total length show up mostly behind the rear window, in the trunk (Comet's trunk capacity is 26.6 cu. ft., compared to 23.3 cu. ft. for Falcon). But from the bottom to the top of Comet's trunk opening measures only 6.4 in., considerably less than Falcon's 17.2. This apparent styling concession could cause problems with large suitcases.

Comet's Future, then, probably depends pretty well on its selling price which hasn't been announced as of this writing. Ford has promised that it will be "quite a surprise."

If, as this seems to indicate, Comet's price turns out to be near Falcon's, then the admittedly-compact Falcon might be in for some tough intra-family competition from its fence-straddling bigger brother.

If Comet's price should approach that of a *full*-size Ford, we'll have to wait and see how many buyers will want to pay Ford prices to get a Comet.



Corvair's new 5-passenger 700 coupe has the same overall length, height, interior trim and air-cooled rear engine as the 4-door sedan. Its sloping rear window is similar to that of a conventional Chevrolet coupe.

This 6-passenger Falcon wagon comes in 2- and 4-door models. Cargo volume, to the rear of the front seat, is 76.2 cu. ft. To the rear of the second seat (which flips over to provide a flat floor) it is 42.7 cu. ft.

More Wagons, Too. Besides 2-door and 4-door sedans. Comet also comes in both 2- and 4-door wagon models, on a 109½-in. wheelbase (which puts them in the category of "compact," according to N.A.S.C.A.R. standards, which say that a car with a wheelbase longer than 110 in., such as a Comet sedan, is *not* compact. Overall length of the Comet wagon is shorter than the sedan too, 191.8 in.

The wagons will be in direct competition with those announced recently by Falcon. All the wagons—Comet and Falcon—have the same engine specs and wheelbase length, but Falcon measures 189 in. overall, which is not quite 3 in. shorter than Comet.

The Falcon wagon's counter-balanced tailgate has a roll-down window, which is operated by a manual crank or with an optional electric control.

Tailgate-floor loading height for both the Comet and the Falcon wagon is a fraction of an inch under 2 ft., about half an inch lower than the standard Ford wagon.

Interestingly, the Falcon wagon's standard rear axle ratio is the same 3.56 as Comet's instead of the standard 3.10 found in the stick shift Falcon sedans. (Falcon's wagon has an optional ratio of 3.89; the sedan has the 3.56 as standard in its automatic transmission models.)

Corvair Adds a Coupe to its line, a 2-door model with the same basic dimensions as the 4-door sedan, but with a sportier look. Its sports appearance results from larger openings for the rear wheels and a restyled, faster-sloping rear window. Inside, the major difference lies in the coupe's split front seat. Corvair, by the way, is now offering a 95-*hp* engine as an option, and Valiant will make a 148-*hp* engine available soon. —WAYNE WILLE.

Comet Measurements and Specifications (4-Door Sedan)

Engine type		In-line OHV 6
Bore and stroke		3.50 x 2.50
Adv. max. horsepower		90 @ 4200
Adv. max. torque		138 @ 2000
Compression ratio		8.7:1
Piston displacement (cu. in.)		144.3
Axle ratios	Manual	3.56
	Auto.	3.56
	OD	None
Overall steering ratio		27:1
No. of turns (lk-to-lk)		4.6
Turning circle (ft.)		39.3
Wheelbase (in.)		114.0
Overall length (in.)		194.9
Overall width (in.)		70.4
Overall height (in.)		54.5
Minimum ground clearance	(in.)	5.9
Overhang (in.)	Front	30.8
	Rear	50.1
Head room (in.)	Front	33.9
	Rear	32.8
Shoulder room (in.)	Front	55.2
	Rear	55.2
Hip room (in.)	Front	57.1
	Rear	57.0
Leg room (in.)	Front	43.3
	Rear	39.4
Seat height (in.)	Front	11.4
	Rear	14.2
Windshield (sq. in.)		1235.3
Read window (sq. in.)		893.3
Trunk (cu. ft.)		26.6
Tire size and ply		600 x 13-4
Gas tank capacity (gals.)		14.0
Oil fill capacity (qts.)		3.5
Radiator capacity (qts.)		8.7

Scientists

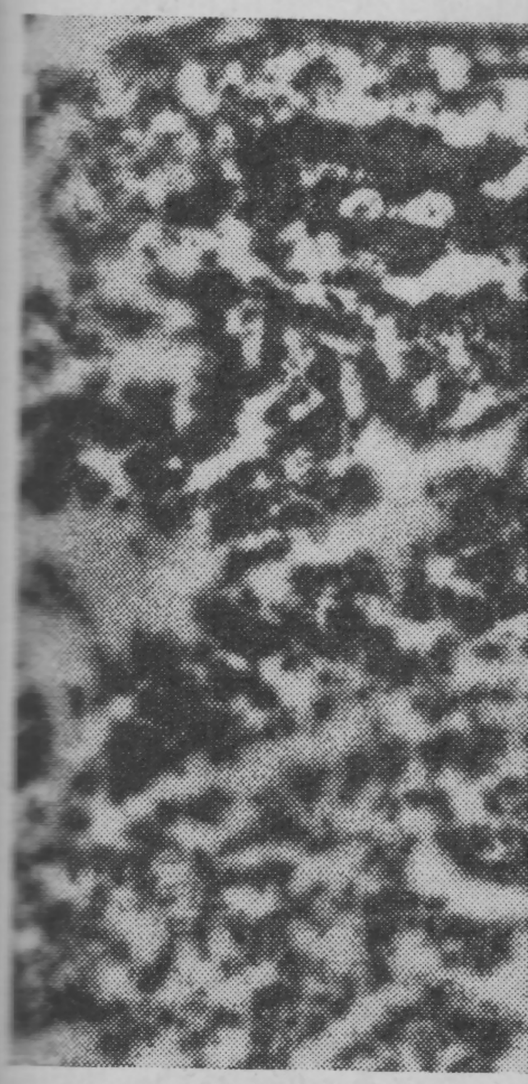
AN upside-down cone pale-blue flame hov ing in mid-air may g clues to solve problems the design of jet airpla and missile nose cones.

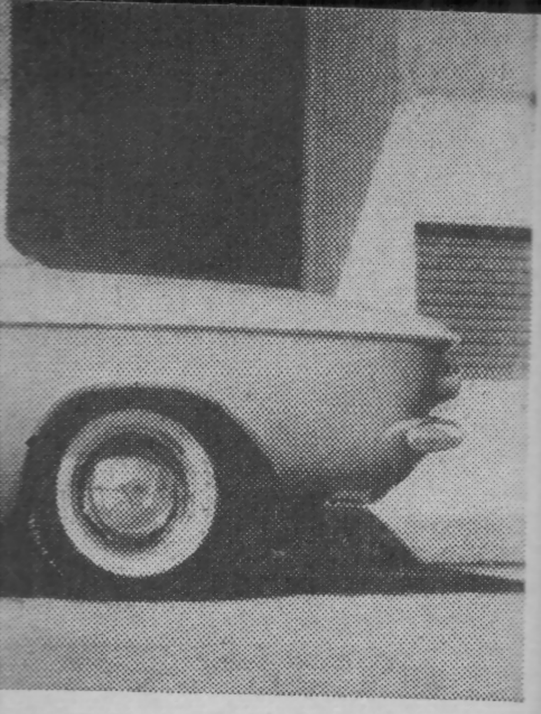
Working with a long, l low, cigar-shaped copper pointed down at the cen of a 6-inch duct, research at Michigan State Univ sity, East Lansing, Mi isolate a flame so that th can study its fundamen nature.

An immediate probl they're working on is fi ing a more efficient way "anchor" a flame in a rap ly moving stream of fuel a air—such as in a jet engi where baffles are now us to intercept and slow t stream.

In the M.S.U. experimen a regulated mixture of fu and air flows up from t duct. The part of the str surface of the rod is slowe layer" fans out, forming a stream continues up the Even though the velocity the duct may be too great a flame *can* be produced

First Photo





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d Specifications (4-Door Sedan)

	In-line OHV 6
	3.50 x 2.50
	90 @ 4200
	138 @ 2000
	8.7:1
	144.3
	3.56
	3.56
	None
	27:1
	4.6
	39.3
	114.0
	194.9
	70.4
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ar	32.8
ont	55.2
ar	55.2
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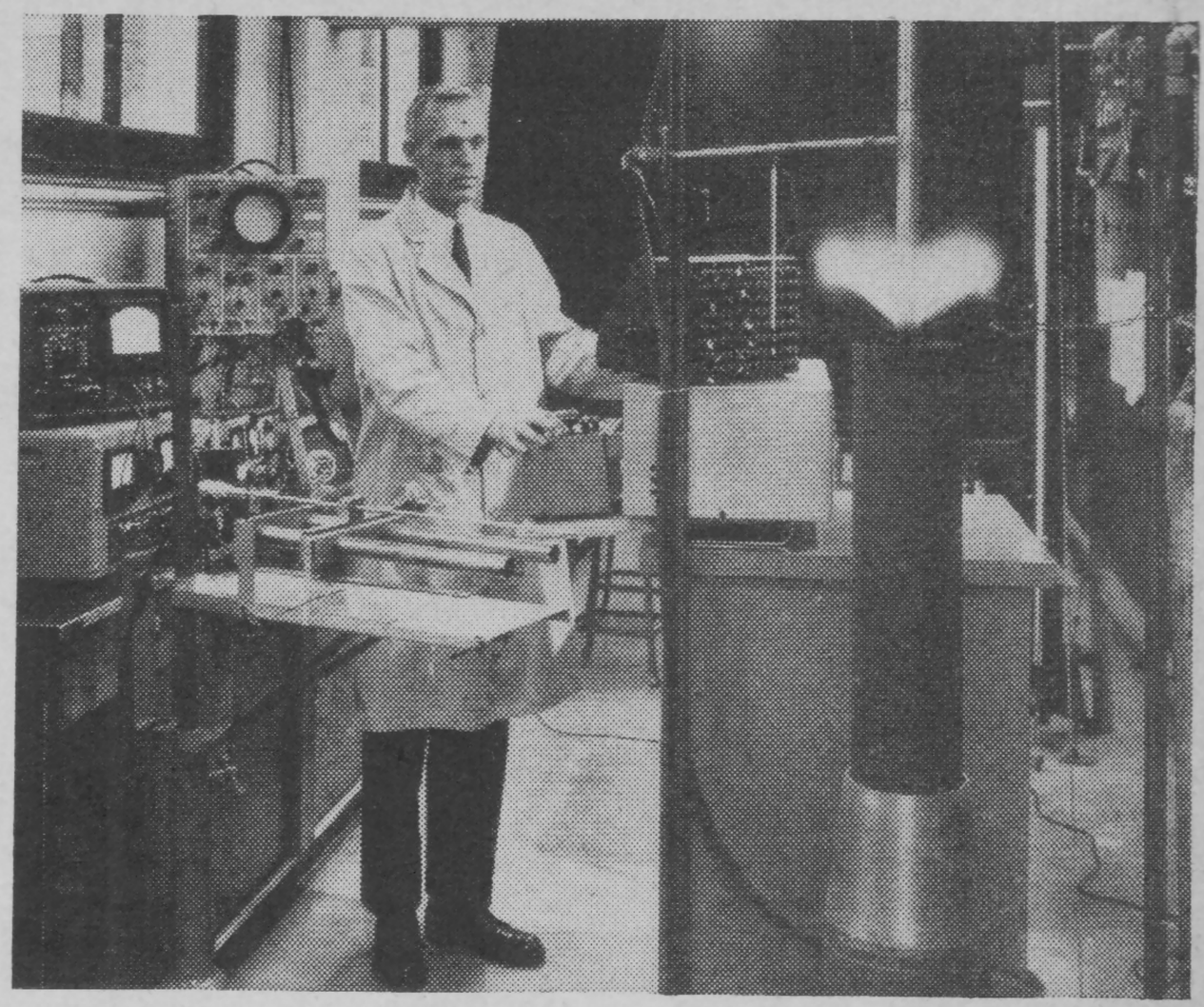
Scientists "Anchor" Flame to Solve Jet and Missile Problems



AN upside-down cone of pale-blue flame hovering in mid-air may give clues to solve problems in the design of jet airplanes and missile nose cones.

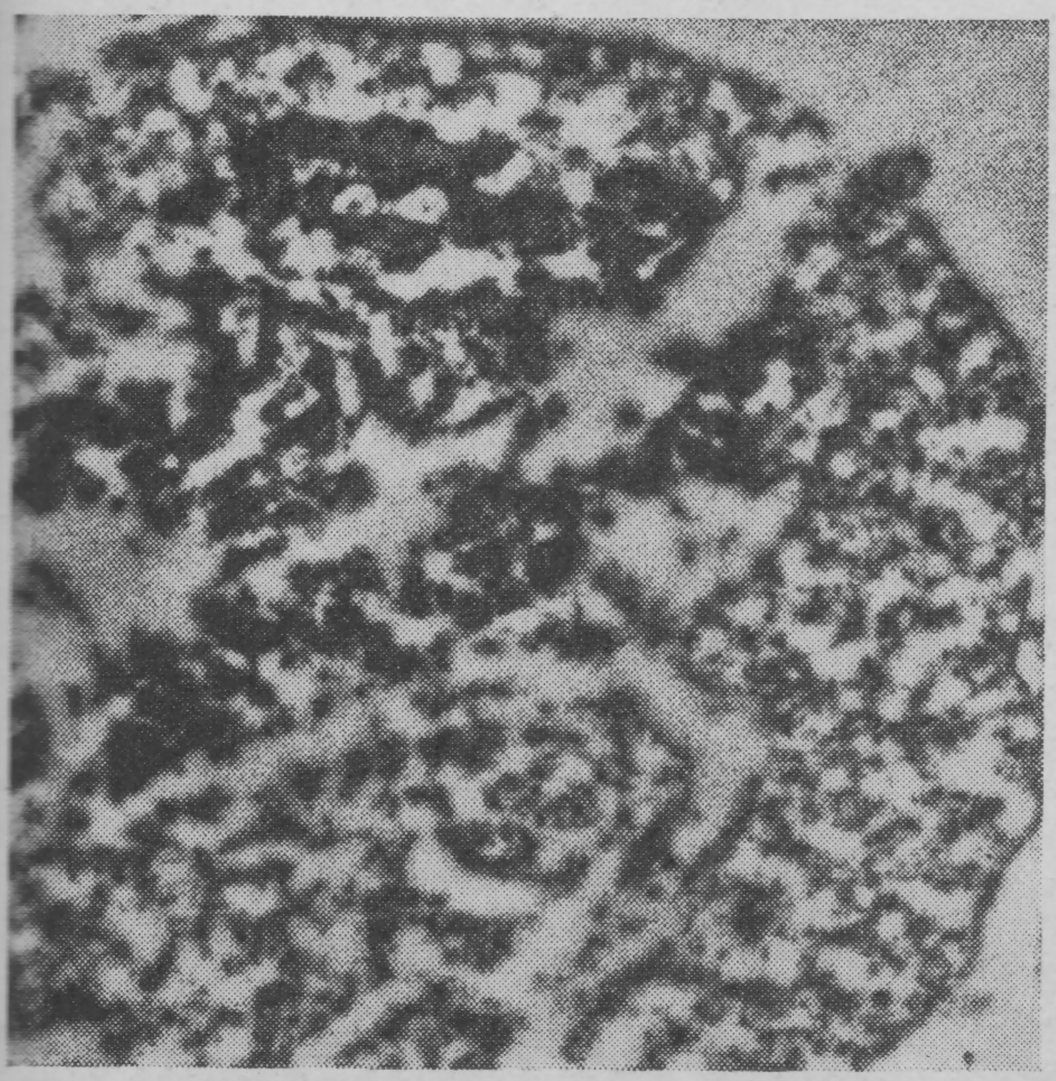
Working with a long, hollow, cigar-shaped copper rod pointed down at the center of a 6-inch duct, researchers at Michigan State University, East Lansing, Mich., isolate a flame so that they can study its fundamental nature.

An immediate problem they're working on is finding a more efficient way to "anchor" a flame in a rapidly moving stream of fuel and air—such as in a jet engine, where baffles are now used to intercept and slow the stream.

In the M.S.U. experiments, a regulated mixture of fuel and air flows up from the duct. The part of the stream closest to the surface of the rod is slowed. This "boundary layer" fans out, forming a cone shape as the stream continues up the rod (see photo). Even though the velocity of the flow from the duct may be too great to support a flame, a flame *can* be produced in the boundary layer—from where it extends out into the main stream.

The researchers say that more knowledge about boundary layers will help missile designers minimize the intense heat that occurs when rocket nose cones re-enter the atmosphere.

First Photo of Polio Virus Inside Human Cell



POLIO viruses for the first time have been seen and photographed inside the human cell in which they were formed.

Besides clearing up some mistaken ideas about viruses, the new research may throw some light on how virus infections and symptoms develop. Drs. D. C. Stuart Jr. and Jorgen Fogh of the New York State Department of Health, Albany, N. Y., say their work shows that viruses apparently are formed not in the nucleus of the cell —as had been supposed—but in the material surrounding the actual cell nucleus.

They also report that some 100,000 viruses are produced in a cell during just a few hours. The research is supported by a grant from the American Cancer Society, since the findings may have some application to cancer if the findings show that the disease is virus-caused.

COCKPIT REPORT

Flight Testing the New Cessna 210

On takeoff, the new 210, first retracting-gear, single-engined Cessna, pulls its legs up in a 5-to-6-second cycle. Although it looks clumsy, action actually swivels hydraulically about a single pivot for each gear.

By RAY WHITMAN
Aviation Editor

IN THE wrong hands, any airplane can be dangerous.

So also, of course, can any auto, or for that matter, any washing machine or screwdriver. Conversely, in the right hands almost any of them can be relatively safe.

Yet, the fact remains that design aims do differ, and it simply is not true that "one is as good as another." Some aircraft designers deliberately try for all the "go, go, go" they can get out of given horsepower; some basically point toward passenger comfort; and some put pilot convenience first.

But when you come to the spanking new Cessna 210, there is no mistaking what the designers were thinking about. This craft, for pilot ease and safety, flatly surpasses anything in its class I have ever flown.

No Graveyard Spiral. Put it this way, for any pilot who has flown high-performance aircraft. The most dread thing in the air is the situation that develops when a VFR pilot (not instrument trained) runs into some low scud (clouds). He does not recognize that one wing has dropped a trifle.

As the lifting increment of the wing falls off a little, the speed increases, because the ship is going down. It has lost a little of its lift, and, if it were trimmed out properly in the first place, it is no longer carrying the weight of the craft on a straight-and-level basis, and she heads down. This increased speed increases the lift on the high wing, and the bank becomes progressively greater; so does the speed; so does the rate of descent. In a moment, you are now in what pilots call the "graveyard spiral." That is the only place it can end, unless a highly proficient instrument pilot takes over and pulls you out. In the Cessna 210, it just doesn't happen.

In flight test, we repeatedly put it into shallow banks with the nose slightly depressed. In some craft, the graveyard spiral would have been on its way. In this one, very gently, very gradually, it simply righted itself and came out flying straight and level, without even the customary oscillations between points of stability. (They would probably have been there had we the instruments to measure it carefully, but we couldn't feel it.)

All of this, being translated, means that the 210 is probably the most stable aircraft of anything approaching its class in the air today.

Frankly, when we approached it, we were skeptical. The idea of a high-winged, high-

On the ground, 210 resembles 182, since covers close after down. It does not look as thou ing gear would retract. Note droop in lower photo.

performance ship with retr gear is on the revolutiona More, its gear retraction looks ungainly (Fig. 3). as though there were two in which the gear first sc in toward the center ar pulls up. Fact is, this is an illusion. Actually, the ma still the Steve Wittman steel arrangement chara of Cessna (see Dec., '59, pivots about a single axi tract.

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Family Resemblance. Wh N-7308-E at O'Hare field glance impression was of Cessna 182. It has simi the ground and a similar tion, but for the drastic (35°) blending gently fr

Wingtips, in for much droop at the end like a W Aerodynamically, this m plane yaws in flight, the presenting a larger profil experiences more drag wingtip, contributing gre ity. The gear doors, whi retraction, also close aft although they can be op

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On the ground, 210 resembles smaller 182, since covers close after gear is down. It does not look as though landing gear would retract. Note wingtip droop in lower photo.

performance ship with retractable gear is on the revolutionary side. More, its gear retraction cycle looks ungainly (Fig. 3). It looks as though there were two phases, in which the gear first scrunches in toward the center and then pulls up. Fact is, this is an optical illusion. Actually, the main gear, still the Steve Wittman spring steel arrangement characteristic of Cessna (see Dec., '59, S&M), pivots about a single axis to retract.

What gives the double-action look is the fact that when you hit the switch and the gear starts back and up, it is first forced back by the pressure of passing air faster than the hydraulic system alone would move it. Then, as it reaches the point where the weight counter-balances air pressure, the movement hesitates a moment until the hydraulic system catches up and completes the cycle.

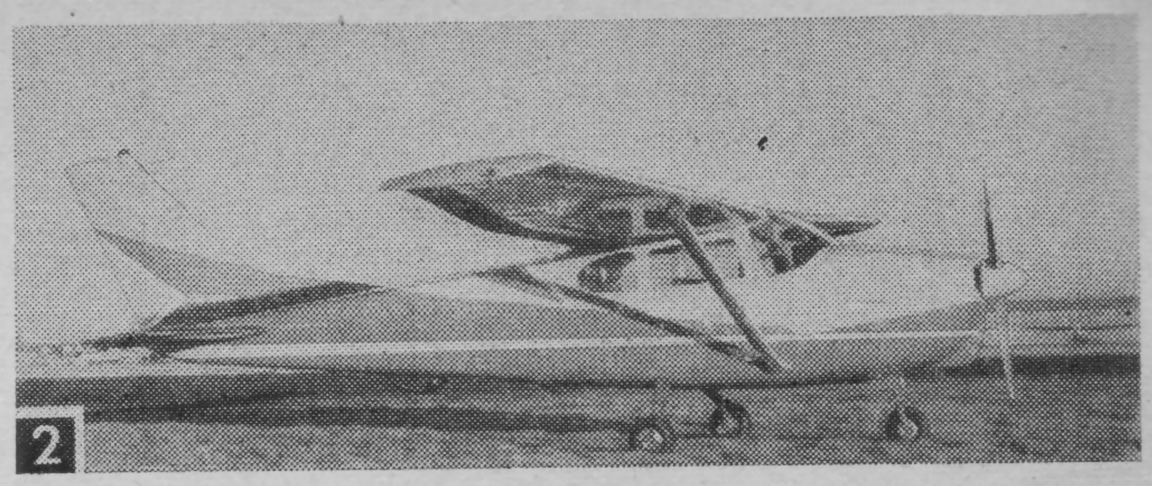
Incidentally, we hope Cessna puts in some rubber to cushion the jolt when the gear hits locked up position. This is all going on right under you, and in the early demonstrator we flew, it locked up with a "kaloomp" vigorous enough to make you wonder if something had fallen off the air machine. You get used to it.

Family Resemblance. When we met Cessna N-7308-E at O'Hare field, Chicago, our first-glance impression was of a slightly overgrown Cessna 182. It has similar-looking gear on the ground and a similar general conformation, but for the drastically swept-back tail (35°) blending gently from the fuselage.

Wingtips, in for much new thought lately, droop at the end like a Walt Disney vulture. Aerodynamically, this means that when the plane yaws in flight, the advancing wingtip, presenting a larger profile to the relative air, experiences more drag than the retreating wingtip, contributing greatly to spiral stability. The gear doors, which close totally upon retraction, also close after the gear is down although they can be opened for inspection.

Inside, this is a plush job. There's real leather and nylon on those seats, they're heavily padded and adjustable headrests are offered ($33 a pair). Deep pile carpeting has a polyester pad beneath, and engine noise is low. Literally, our back-seat test flight passenger *fell asleep* back there, of all times, while we were doing a series of stalls in all configurations! (More about those stalls later.) It carries four in virtual airliner comfort.

One of the best-organized panels we've seen



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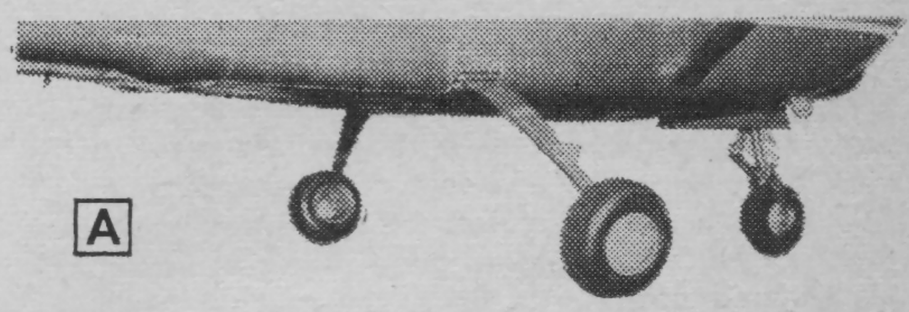

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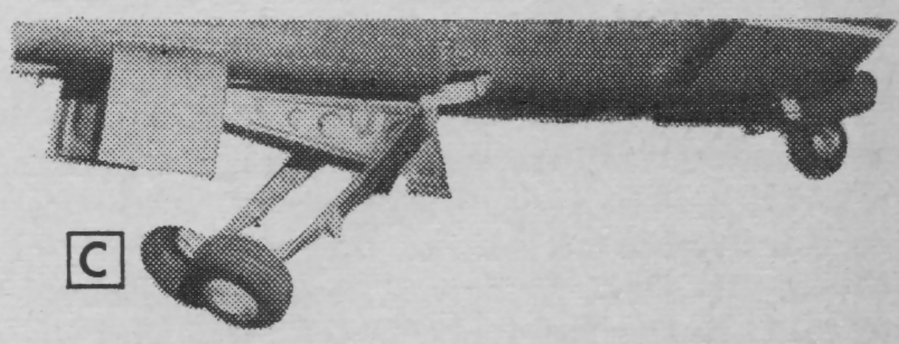
B



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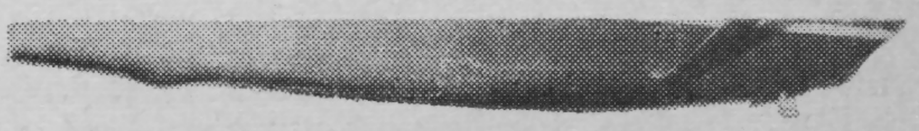
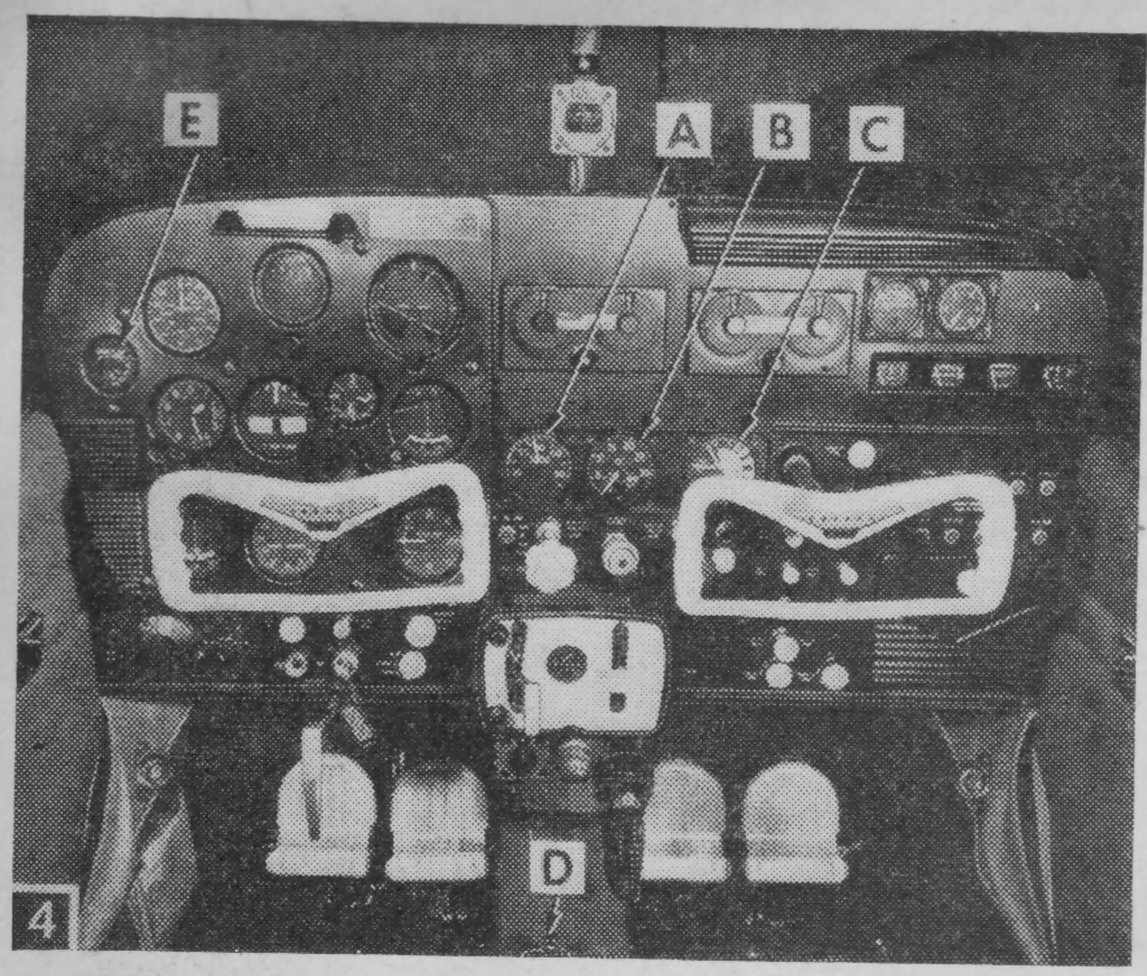


3 E

Retraction cycle of 210 starts with gear down (A). Covers open to accept gear (B); main gear starts back, nose gear forward and up (C); gear up, doors start to close (D), and cycle completed (E), no opening remains.



Exceptionally well designed panel groups each engine control with appropriate gage: Throttle with manifold pressure (A); prop pitch with tachometer (B); and fuel pressure with gage (C). Gear and flap controls are on console at center below engine instruments; flight gages, at left before pilot, radios at upper and upper-right center, and trim (D) in floor, center. Flap position indicator (E) is at extreme left, but visible from right seat.

carries gadgets to manage the hydraulic gear and flaps and the 260-*hp* fuel-injected engine (Fig. 4). I especially liked the fact that each engine control has its matching gage directly above: manifold pressure above the throttle, tachometer above prop pitch control and fuel pressure gage above mixture, all controls on silky-smooth verniers and dead center between co-pilots. Directly below them are easily identifiable gear and flap levers, plus the hand pump for emergency use in hydraulic power failure, and there's a reservoir with 125% of hydraulic system fluid on standby in case of a leak.

Flying It Out. I flew "Zero-Eight-Easy" out of O'Hare (field alt. 666 ft. msl.) with Dwayne Jose, Cessna eastern district sales manager, World War II B-29 and Korean P-51 pilot, on the right, and Bill Robinson, director of Cessna Public Relations, in the back. This, with ¾ fuel and some luggage put us about 300 lbs. under maximum gross of 2,900 lbs. We went off runway 32-right with an 18 *mph* crosswind at almost 90°, temp. 40.3°F, bar. 29.31 in. Hg.

In this condition, we broke ground (flown off, not pulled off) in just about 600 ft., a good 140 ft. less than manufacturer's specs, at just over 60 *mph*. Right from there, the 210 took the bit in her teeth and went on to exceed Cessna's claims in every single respect we had time to check, all of it with "no-sweat" ease on a clear December day.

At about 75% power (24 in. manifold pres., 2450 *rpm*, 10 lbs. fuel pres.), she took out at an initial climb rate of more than 1400 *ft./min.* (mfg. 1300). Peeled back to an economy setting of 65%, she continued climb up to 6500 ft. at an almost steady 1100 *ft./min.* Incidentally, at such climbing angles, you'd better S-turn a bit, for that panel and forward cowling are a little higher before your eyes, because of the larger engine, than in other single-engined Cessnas.

Trimmed out to cruise at 75% at 6500 ft., our computer insisted we were covering ground at a true, healthy 193-195 *mph*, as against the maker's claim of 190 at 7000 ft. At economy cruise at 65%, we read it at 190-192 *mph*, as against the claimed 186. But that's only a fraction of the story.

She Flies Herself. Out of ground turbulence, you fly this one like an airliner, by the trim tabs. Elevator trim is highly sensitive; rudder, only a little less so. And once trimmed, the wheel becomes a thing to hang your gloves on, the rudder pedals a place to rest your feet, if you care to. Occasionally, you tap a control with your fingertips or a light toe, and that's it.

All control pressures, including rudders, are light and remarkably quick for so large a ship. You can make aileron-only turns without moving the ball out of the cage and almost without back pressure (we found ourself climbing in the first few). You can make

SPECIFICATIONS

MODEL: Cessna Aircraft Co., Wichita, Kans., Model 210.
ENGINE: Continental IO-470-E (6 cyl.) 260 hp at 2625 rpm.
WEIGHTS: Empty: 1,839 lbs. Max. gross: 2,900 lbs. Useful load: 1,061 lbs.
FUEL: 55 gals.
USEFUL LOAD ABOVE FUEL AND OIL: 708.5 lbs. (4—170-lb. adults plus 28.5 lbs.)
DIMENSIONS: Wing: 36'7", Length: 27'9", Height: 8'8½" (8'11" with rotating beacon).
RANGE: 700 to 1135 miles, depending on altitude and power setting.
PRICE: $22,450 plus extensive radio, comfort options.

PERFORMANCE TEST DATA

Manufacturer's figures are based on U. S. Standard Atmosphere 59°F, 29.92 in. hg. in still air. S&M results taken at O'Hare International airport (Chicago, Ill.). Altitude 666 ft., temp. 40.3°, barometer 29.31, relative humidity 69%, wind 18 mph. almost 90° off runway. Plane flown at about 300 lbs. under max. gross.

	S&M Tests	Mfr's. Statement
Stalling Speed: 59 to less than 40 mph depending on configuration (see text)		59-65 mph
Cruising speed: 193-195 mph @ 6,500 ft.		190 mph @ 7,000 ft.
Climb rate: 1400-plus ft./min.		1300 ft./min.
Take-off run: 600 ft.		740 ft.
Service ceiling: not verified.		20,700 ft./min.

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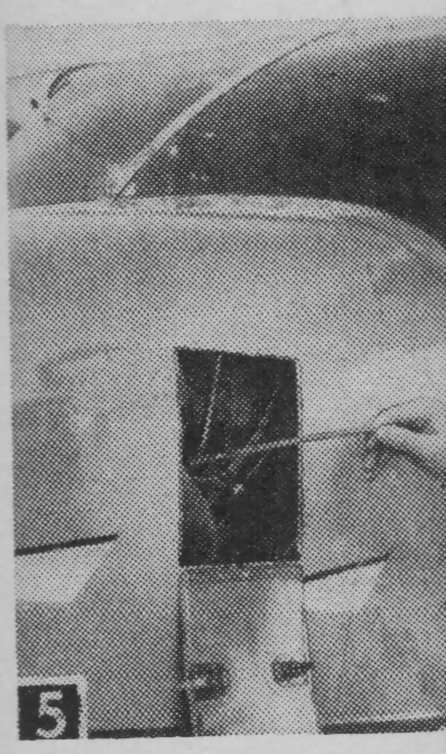

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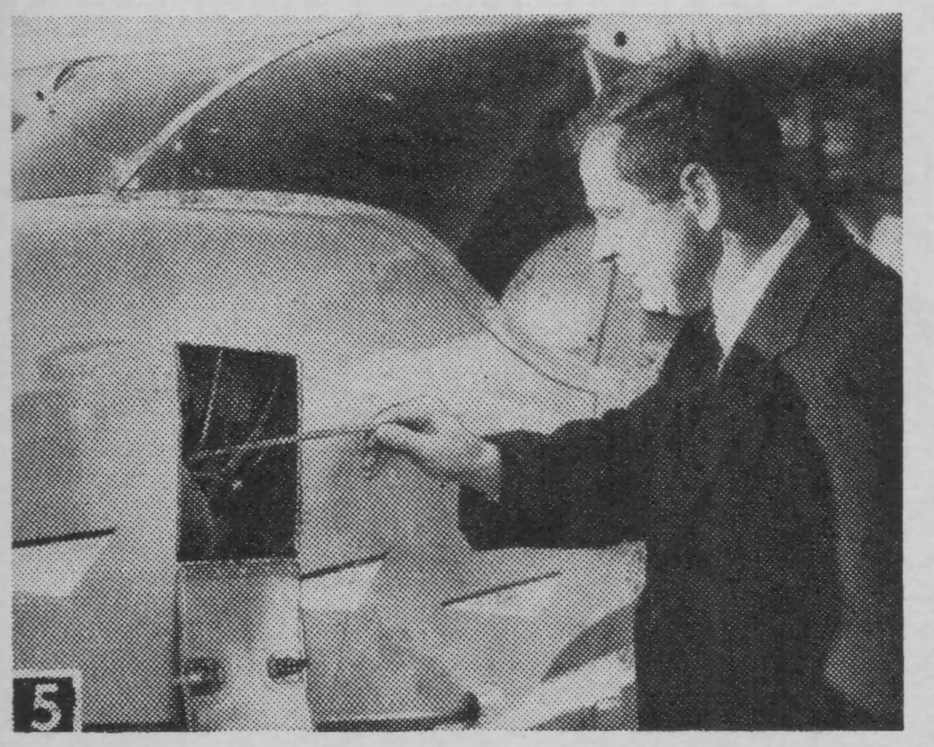
	Mfr's. Statement
mph de- t)	59-65 mph
500 ft.	190 mph @ 7,000 ft.
	1300 ft./min.
	740 ft.
	20,700 ft./min.

SCIENCE AND MECHANICS

rudder-only turns that are only a trifle more sloppy. In a nominal bank, she will stay there all day. In a steeper bank, she will come back to straight and level hands-off, with only minor oscillation. Raise or depress the nose and let go and you get the same result—all of this in any flight regime we found.

Let's try those stalls, for instance. Gear and flaps up, clean, straight and level, power off, she broke gently under 60 *mph* (mfg. 65); in a 30-40° bank, just above 65 (mfg. 75); in a 30-40° bank, gear down and full (40°) flaps, she held on down to about 60 (mfg. 67), and similarly dirty, straight and level, she kept flying down below 55 (mfg. 59). Most remarkable, with just a little power, perhaps ¼, in the same configuration, we caught a reading just a trifle above the lowest airspeed indicating point of 40, and you can't do much better than with the lightest two-place trainers!

Or let's handle it slowed up to pattern speed of, say, 80, with gear and flaps, holding altitude with minimum power. Here she is rock steady, just as at cruise, with no fishtailing, and perfectly firm in turns steep enough to feel perceptible G loads. Or try an emergency let down. Take off power and drop gear anywhere under 160, and immediately feed in 10° of flaps. Start trimming back, and at 110 bring in the rest of your flaps. Get the trim all the way back, now, and, just to make things interesting, turn it



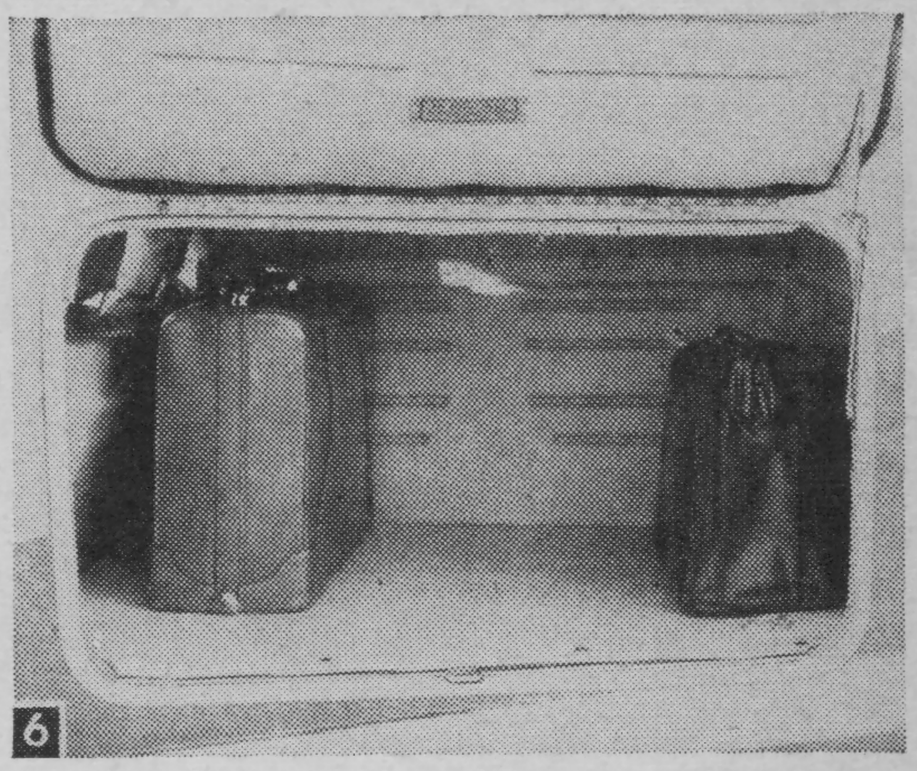
Oil dipstick and fuel sediment-moisture check points are accessible through cowling port with two snap-lock fasteners. Dwayne Jose, (pictured), Cessna Eastern sales manager, says entire cowling, both sides, will come off in less than two minutes.

into a 30° bank and let go of all the controls.

In a great many craft, you have just committed suicide, unless you act quickly. In the 210, your speed stabilizes at about 80 *mph;* your turn holds right where you put it, no tightening, no winding up; and your descent oscillates between 1,000 and 1,500 *ft/min.,* never going higher. That's all. You come out of it as easily as you went in.

All stalls, including the climbing turn, break decisively, but gently enough, as we said, not to awaken a back-seat passenger. All have adequate warning buffet, and all can be recovered in 50-100 ft.

Landings are made tail-low, almost as in



Luggage compartment of 210, 120 lbs., will take four "two-suiters" side-by-side. Door which locks with key is spring-loaded up like your car trunk lid, as is ventilation window at pilot's left.

conventional-geared craft, and once on, she stays, with no tendency to balloon.

In short, a pilot would have to be nothing less than a blithering idiot to get into trouble with the Cessna 210 in any normal flight operation.

Young Pilot's Friend. Probably nothing in the air can be more dangerous than the newly licensed pilot. He promptly wants to get into bigger, heavier, faster and hence more complex ships than the trainers in which he learned. If not watched closely, he's likely to find himself in ships that are over his head.

We think the 210 can prove to be the easiest ship being built today in which to make this transition from lighter to hotter flying. And we think, too, it will carve an immediate market among the host of companies and individuals who want to be in the front rank of cross-country transportation without the much greater costs of a multi-engined ship.

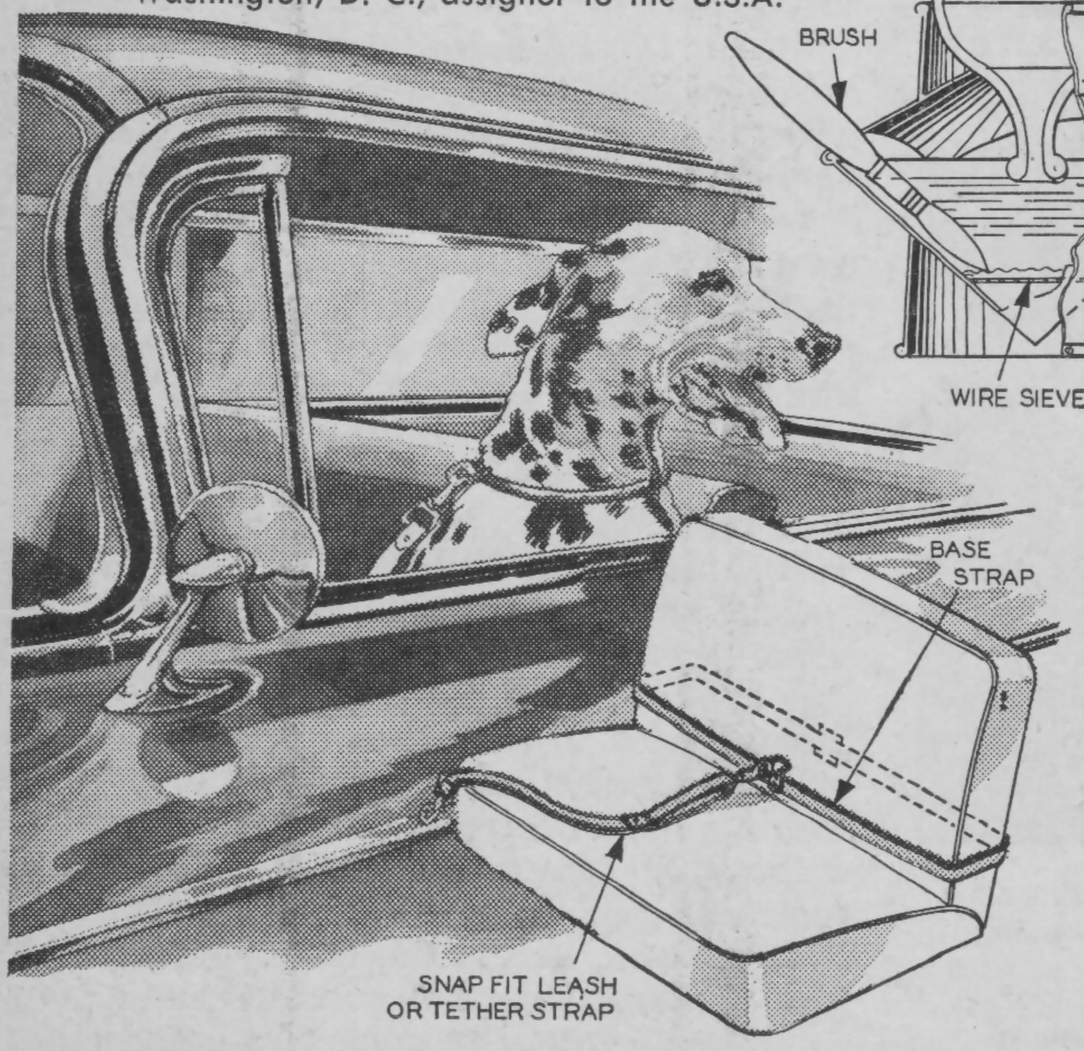
To Cessna, it fills the competitive product gap between the firm's lighter and slower single-engined ships, none of which have retractable gear, and the much more expensive twin-engined 310. It is aligned squarely against leading products of its major competitors, both in price and in speed performance.

It's an awful lot of air-machine, and, we think, a standout for flying ease and safety. You'll have a job beating it.

Parade of New P

Arctic Face Mask, made of stretchable fabric, is cleared of frost and ice by stretching and relaxing the mask itself. Its visual opening has strips of similar fabric, which replace the usual goggles and guard against snow blindness. Patent No. 2,909,782. Louis R. Mizell, Washington, D. C., assignor to the U.S.A.

Constant-Clean Brush Holder. This handy gadget solves the vexing problem of having to clean your brushes between sessions on a king-size painting job. Just put the brushes in the apertures provided, and the constant-level solvent keeps them in shape for next time. Patent No. 2,908,026. Vernon S. Brewer, Jr., West Chester, Pa.



Dog Tether Strap is for motorists who want to take Fido along in the car but hesitate to do so because of the nuisance he can create. This adjustable strap can be fitted to front or back seat to keep him from hopping around. Patent No. 2,909,154. Lewis E. Thomas, Euclid, Ohio.

Tear-Strip Key. The key used to open tear-strip containers is apt to be tricky to use and often results in cuts to the user. This one winds the strip off safely. Patent No. 2,884,158. Edward O. Then, Newark, N. J., assignor to American Can Co., New York, N. Y.

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inventions shown here, you ma
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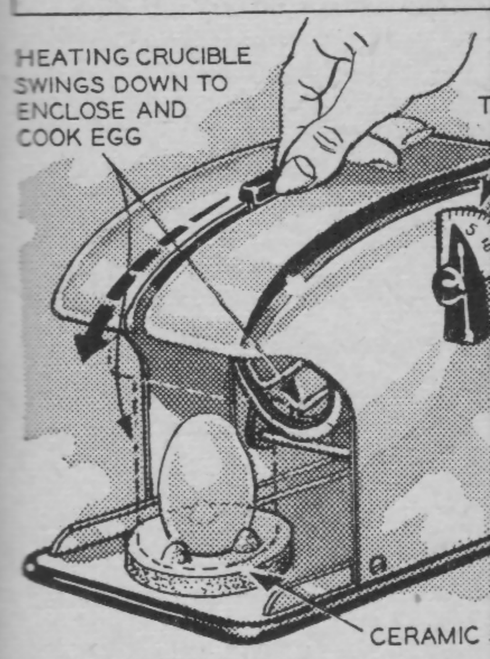

Individual Egg Cooker. This i
is intended to eliminate som
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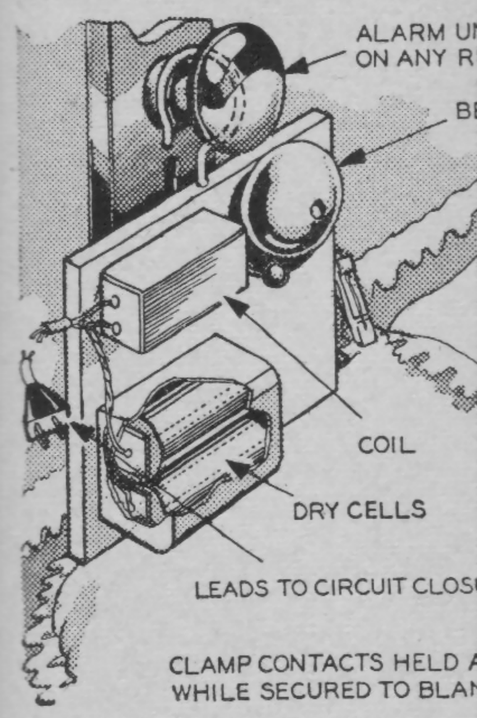
to just plain hard boiled. Pa
2,908,213. A. A. Locke, Algon



Baby Alarm goes off when b
ets. Electrical conductors a
fastened to the blanket and
alarm. If the blanket is kic
make contact, setting off
2,908,899. Dermont B. Cr

Sand Dispenser for cars pr
Just hook the sand-containe
and position the discharge
the switch into the cigarett
sand is automatically releas
No. 2,909,383. Ernest C. N

ade of New Patents

tant-Clean Brush Holder. This
gadget solves the vexing prob-
f having to clean your brushes
en sessions on a king-size paint-
b. Just put the brushes in the
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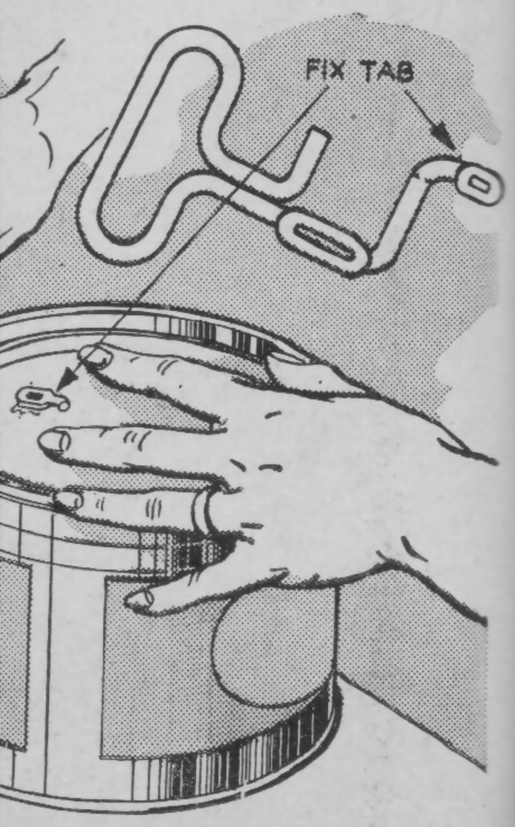
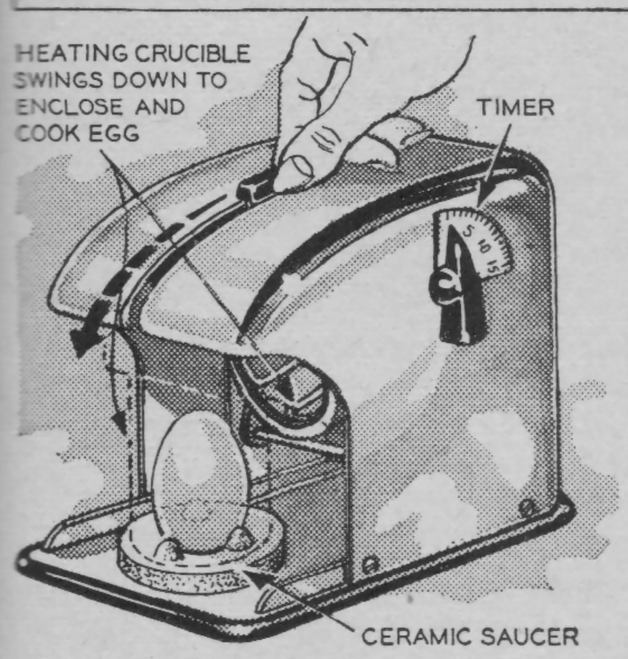
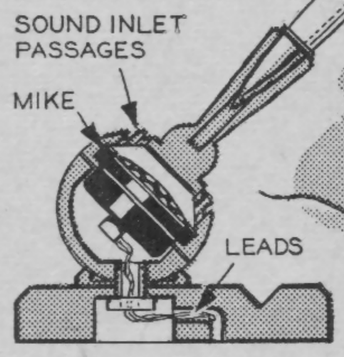


• For more complete information on any of the inventions shown here, you may order copies of each original patent by sending your request with the patent number to Commissioner of Patents, Department of Commerce, Washington 25, D. C. Enclose 25¢ in cash for each patent.

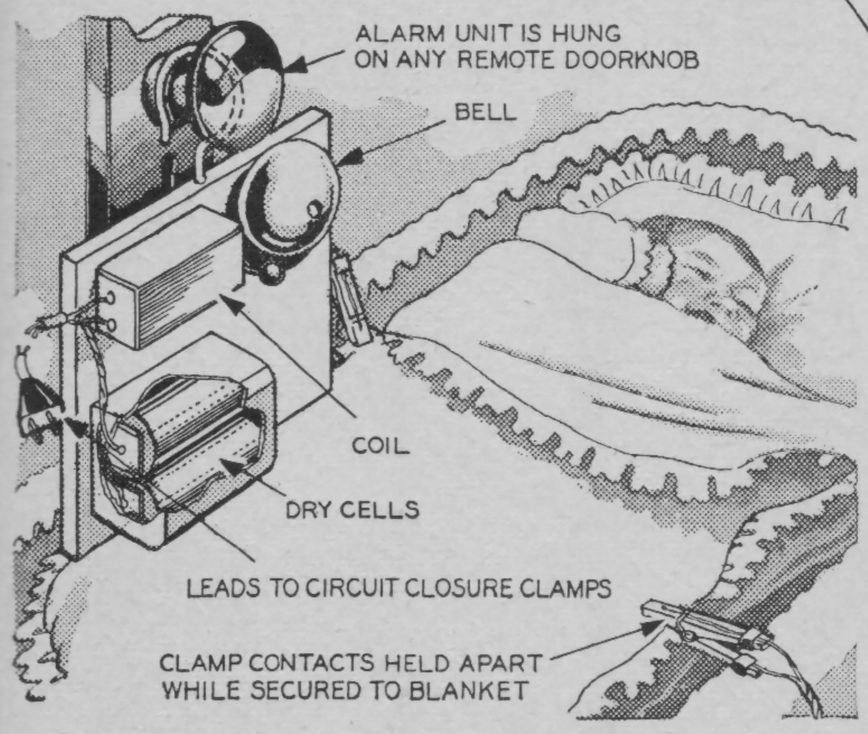


Individual Egg Cooker. This invention is intended to eliminate some disadvantages which the inventor claims come from boiling eggs in water. The timer works automatically and permits cooking your egg from medium soft to just plain hard boiled. Patent No. 2,908,213. A. A. Locke, Algonac, Mich.

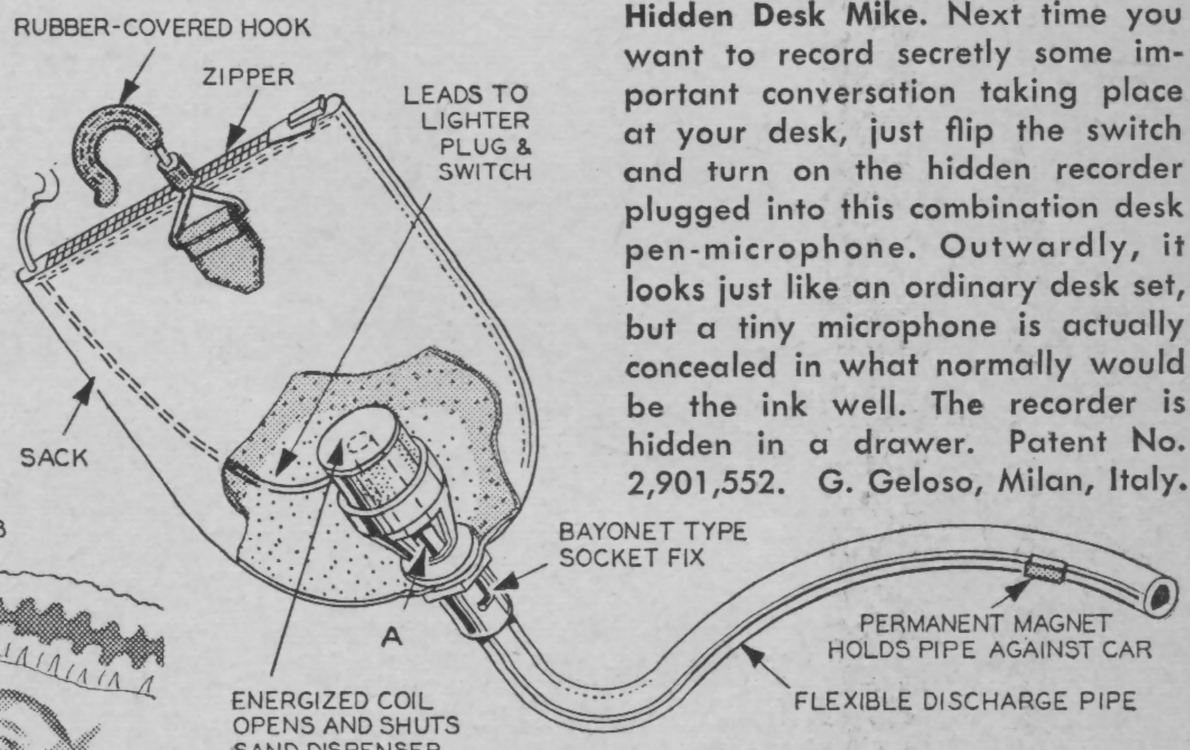


SECTION THRU DESK-PEN SET MICROPHONE

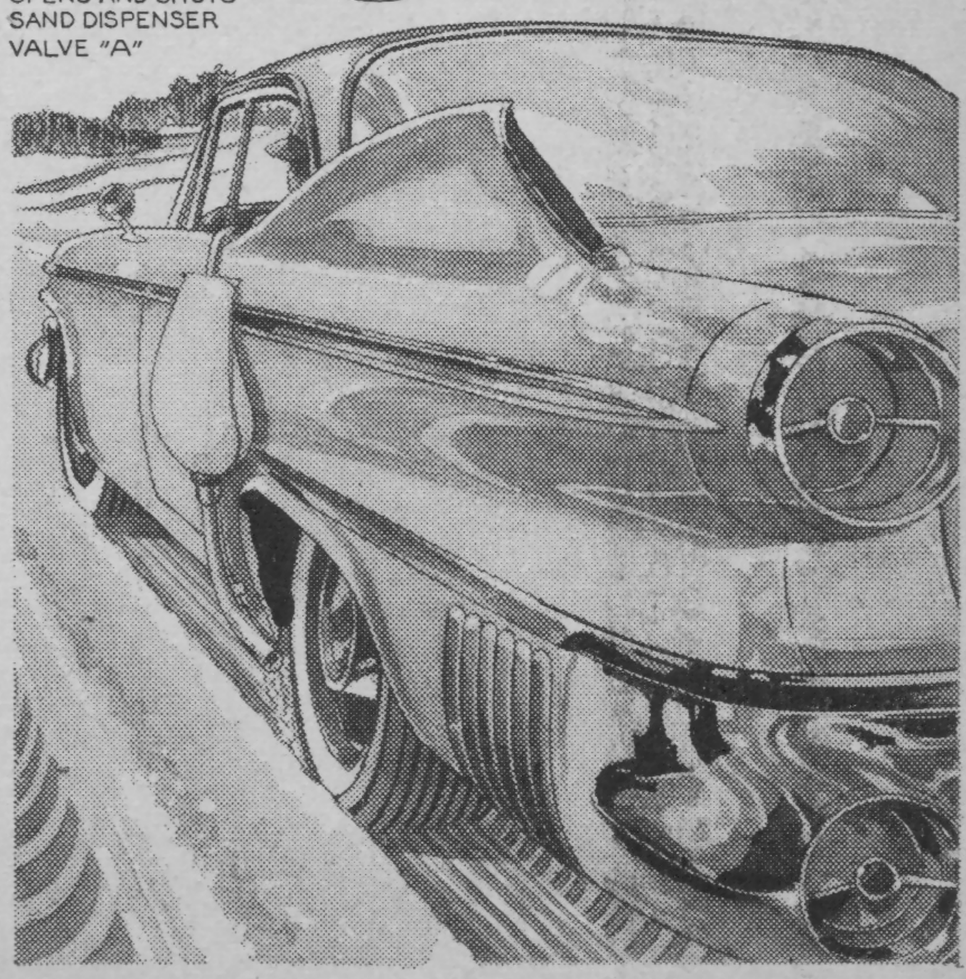
Hidden Desk Mike. Next time you want to record secretly some important conversation taking place at your desk, just flip the switch and turn on the hidden recorder plugged into this combination desk pen-microphone. Outwardly, it looks just like an ordinary desk set, but a tiny microphone is actually concealed in what normally would be the ink well. The recorder is hidden in a drawer. Patent No. 2,901,552. G. Geloso, Milan, Italy.



Baby Alarm goes off when baby kicks off his blankets. Electrical conductors are mounted on clamps, fastened to the blanket and hooked up to a distant alarm. If the blanket is kicked off, the conductors make contact, setting off the alarm. Patent No. 2,908,899. Dermont B. Crafts, Auburn, Maine.



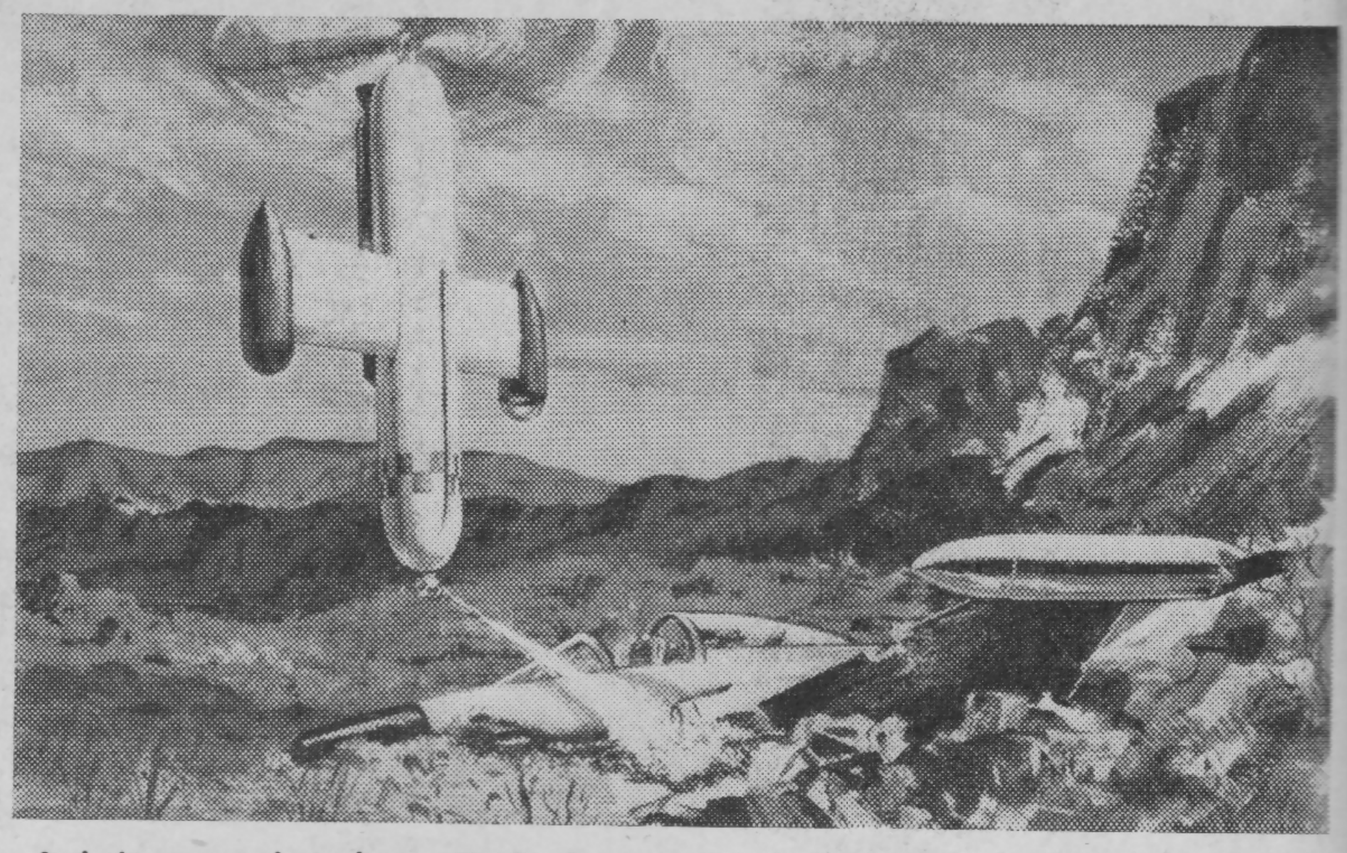
Sand Dispenser for cars provides non-slip traction. Just hook the sand-containers to the window trim and position the discharge pipe. To operate, plug the switch into the cigarette lighter opening, and sand is automatically released as you drive. Patent No. 2,909,383. Ernest C. Nanfeldt, Paterson, N. J.



"Firefly" Rocket Would Fight Blazes

SOMEDAY soon this guided missile—called the *Firefly*—might be used to knock out blazes at the push of a button.

It would be launched like a rocket. Then, guided electronically from the ground, it would fly anywhere within five miles in 40 seconds. Nearing the fire, it would convert into a helicopter and hover while its radar and electronic sensing devices locate the blaze, determine its size and send this information to the remote operator. He could then flip a switch to spray up to a ton of extinguishing liquid.



Artist's conception shows Firefly hovering and spraying extinguisher to control incipient fire. During initial period of flight, rotor blades would lock back to serve as tail surfaces. It would convert to 'copter by unlocking rotors and firing up small rocket motors in each rotor blade tip.

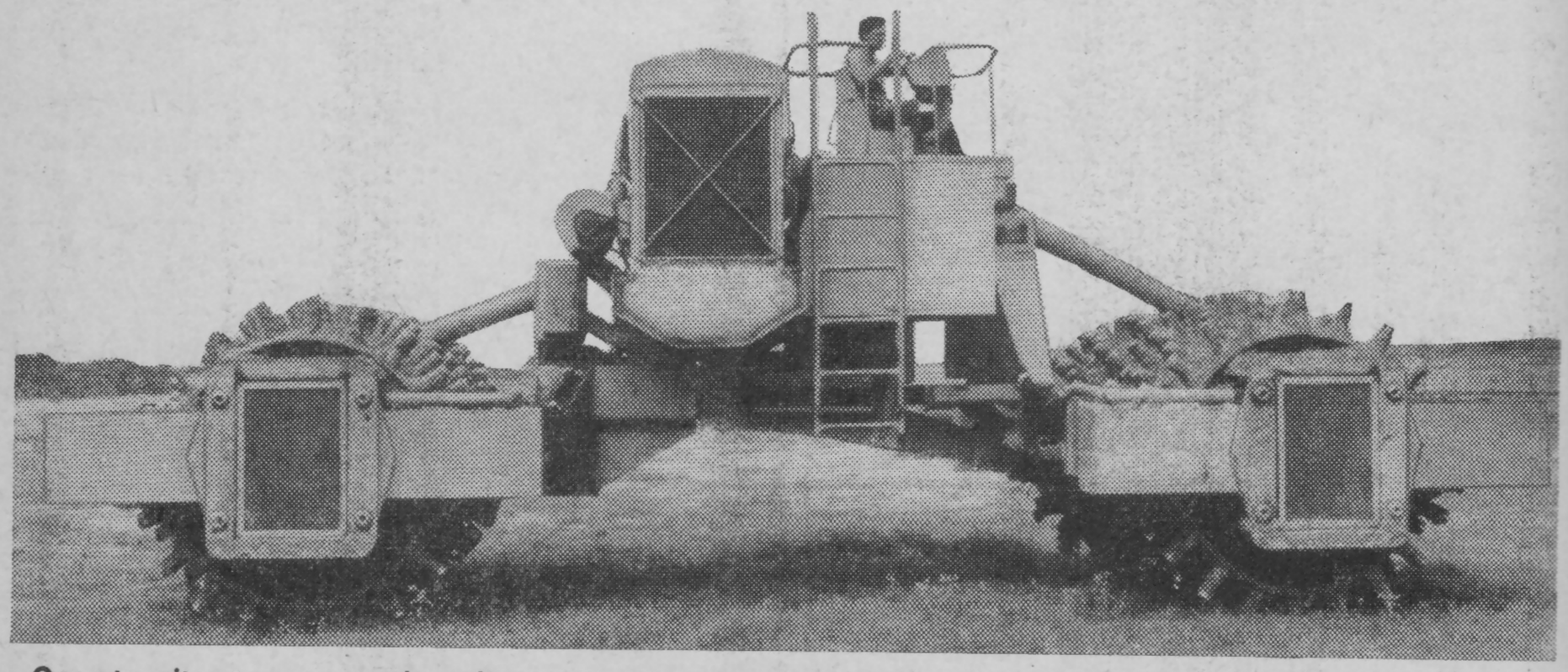
Research engineers who are working on *Firefly* at Solar Aircraft Co., San Diego, Calif., say no new technology is needed to make the missile operational. It could be built merely by perfecting existing equipment and systems. Although the missile could be adapted for almost any firefighting use, it probably will be used mainly at airfields, where it could be tied in with conventional firefighting equipment.

Giant Earth Packer Speeds Highway Building

THIS giant, self-propelled earth packer can travel in either direction without turning around—thus speeding up the building of roads, dams or other large construction projects.

Similar in appearance to the old-time steam roller, it has hundreds of flat circular "feet" which grind down the earth to make a solid foundation.

Each of its four rollers is powered from within by a d-c electric motor geared to the inside rim. Power for the motors comes from two generators, driven by a 420-*hp* diesel engine. The new, 45-ton machine, called *Power Packer,* is built by R. G. LeTourneau, Inc., Longview, Tex.



Operator sits atop new earth packer in a revolving seat which—along with panel of electric controls—can face in either direction. Rollers can move backward and forward over a given area at the rate of about 300 fpm.

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P. 85, Apr. '59 S&M).

**Flash of man-made lightn
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with 3-in. plastic "dots"
choose from five bright**

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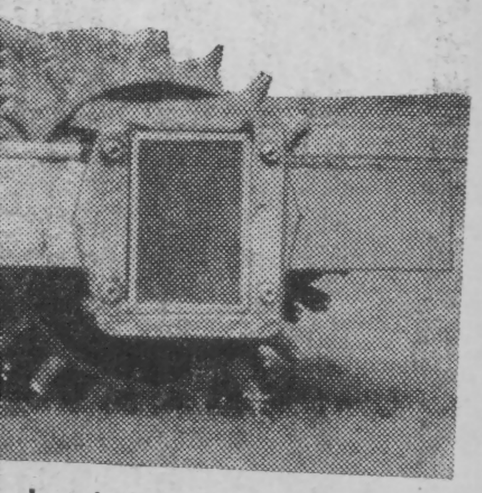


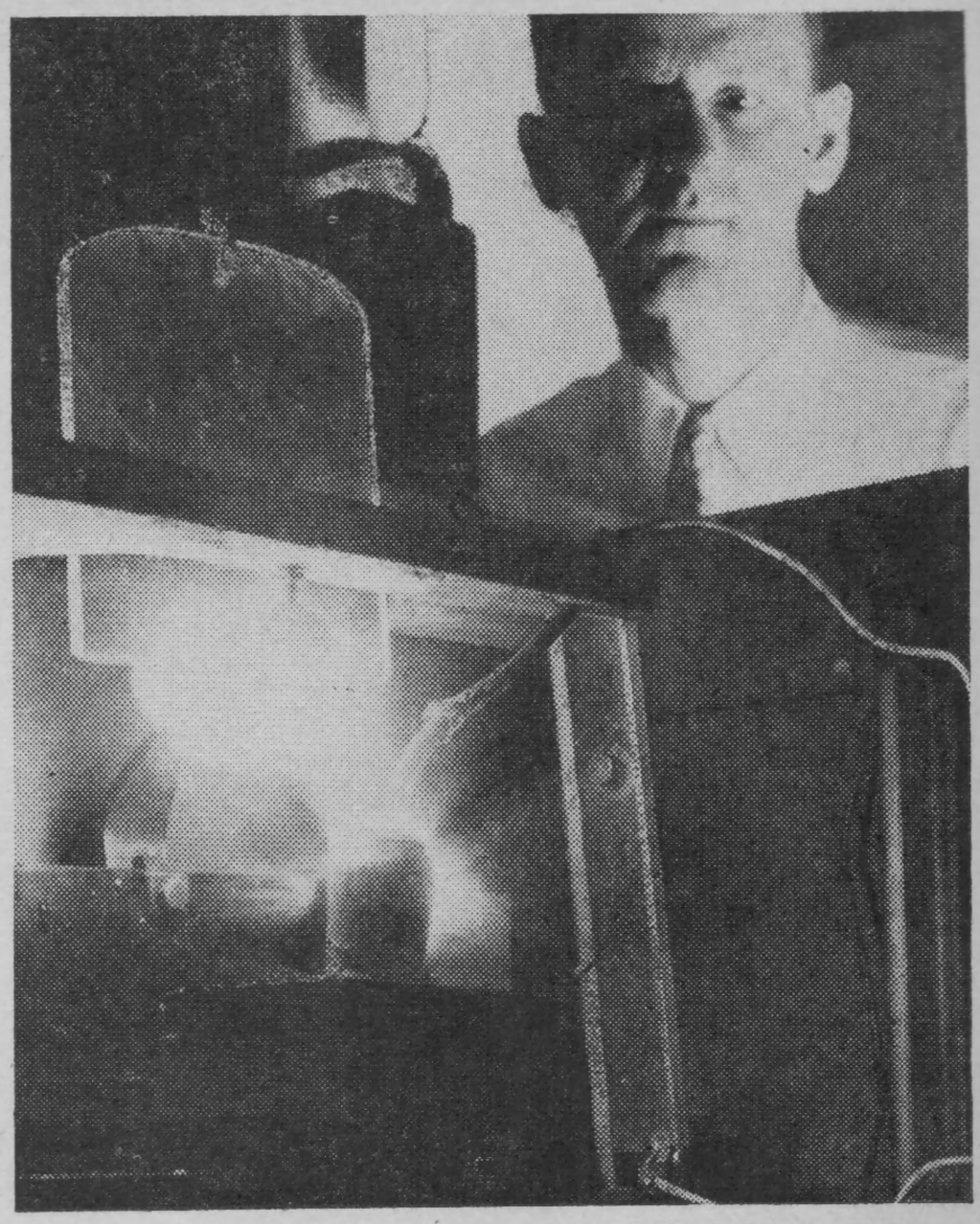
electric controls—can face
he rate of about 300 fpm.

Man-Made "Lightning" Forms Metals

THE device shown here creates underwater "lightning" to convert electrical energy into mechanical power without the use of electrical motors.

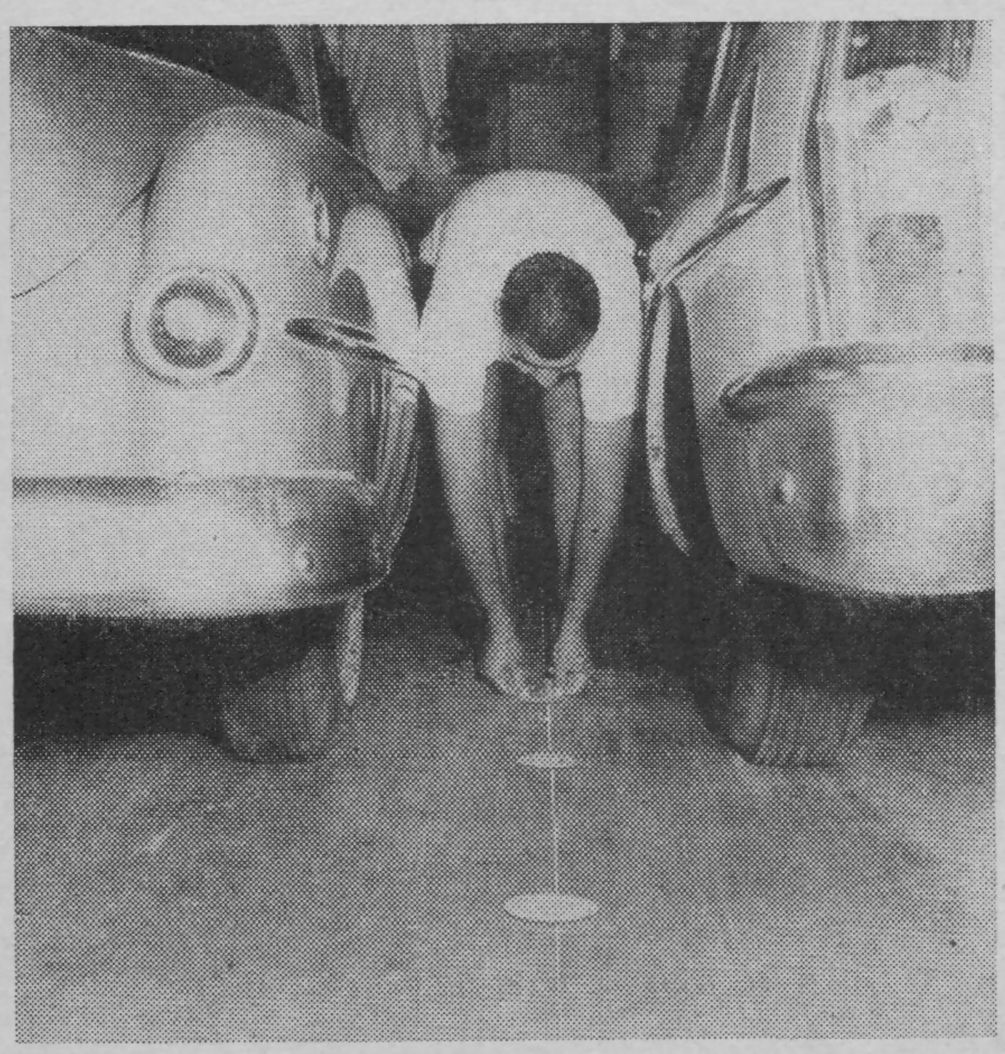
It is called a "spark bomb" by its developers at Republic Aviation Corp., Farmingdale, N. Y., and is being used experimentally for some metal-forming operations.

Electric power is fed into a battery of capacitors. Wires from the plus and minus terminals of the capacitors are attached to two electrodes immersed in water. When a discharge switch is released, an explosion occurs, complete with lightning flash and thunderclap. The resulting spark travels through the water at high velocity, creating a shock wave that does the forming work (see P. 85, Apr. '59 S&M).



Flash of man-made lightning triggers underwater explosion that bulges an aluminum tube with 6000-hp force. New technique could solve problem of forming space age metals that have little stretchability and now require expensive equipment to shape them to close tolerances and aerodynamic smoothness.

Make 'Em Toe the Dotted Line



You won't have to worry about getting over too far to the center of your two-car garage if you mark the stalls with 3-in. plastic "dots" as this fellow is doing. You can choose from five bright colors—yellow, red, green, orange and white.

WITHOUT paint or paste, you can easily mark off the stalls in your two-car garage or lay guide lines down the driveway so the little woman won't clobber the fence.

Making 'em toe the dotted line is easy—with self-sticking, vinyl plastic markers that adhere to just about any surface and can be bought in assorted shapes and colors.

For that guide line up the driveway, you'd likely use 2 or 4-in. dia. plastic "dots," spaced about a foot apart. Colorful directional arrows, up to 5 in. in length, will brighten your circular drive, and you can use 3-in. dia. dots to divide your garage into car-stalls.

A dry adhesive, coating the marker's backs, makes application easy. Simply draw a chalk line as guide and press the markers firmly into place. Unlike painted lines, your markers can easily be removed and relaid. And they are long-lived, up to five times the lifespan of aisle-marking paints. Made by W. H. Brady Co., Milwaukee, Wis., the dots are impervious to most common solvents, oils, greases, acids and water and are washable and fade-proof.—JAMES JOSEPH.

Man-Powered Aircraft A-Coming

Piloted by its inventor, Emil Hartman, Britain's pioneer flapping-wing aircraft soars off the ground during testing in late 1959. This ornithopter was towed aloft by a car in what is thought to be the first flight ever made by a mechanical bird. Next step is an attempt to keep the craft airborne.

THREE inventors—working in Great Britain—have stolen a march on our rocket-age designers. They are working on what could be the first really successful man-powered aircraft.

One of the planes, a genuine, wing-flapping mechanical bird, has begun testing at a jet runway near London. At present, it is not expected to take off by itself, but has been towed off the ground before making test flights.

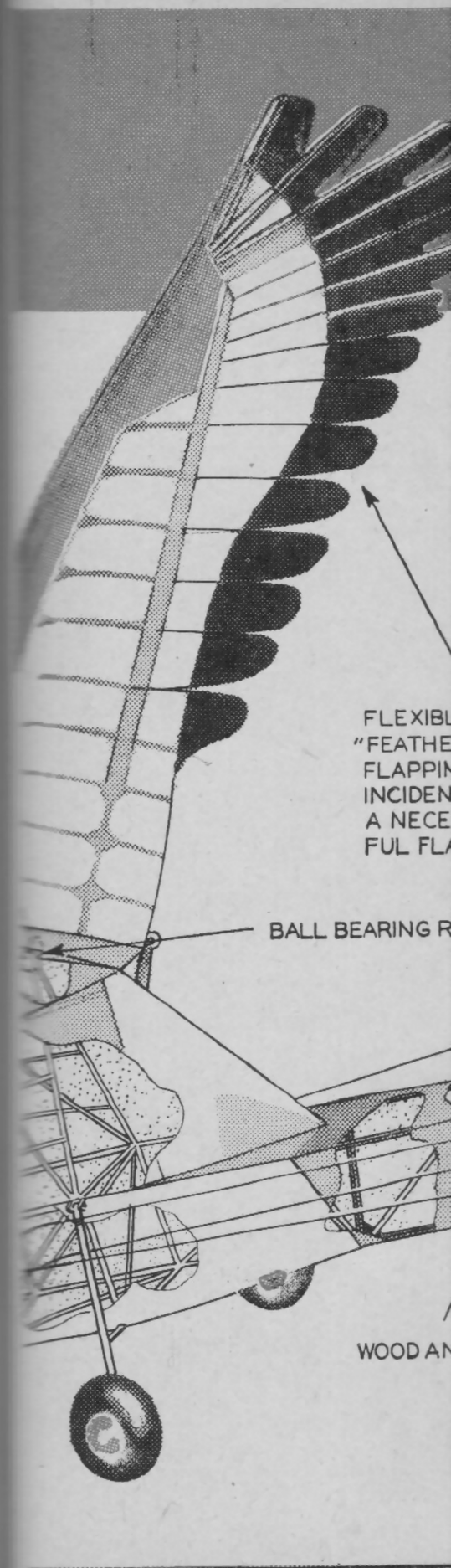
The other two experimental craft are pedal-planes, powered by bicycle-like mechanisms which drive propellors.

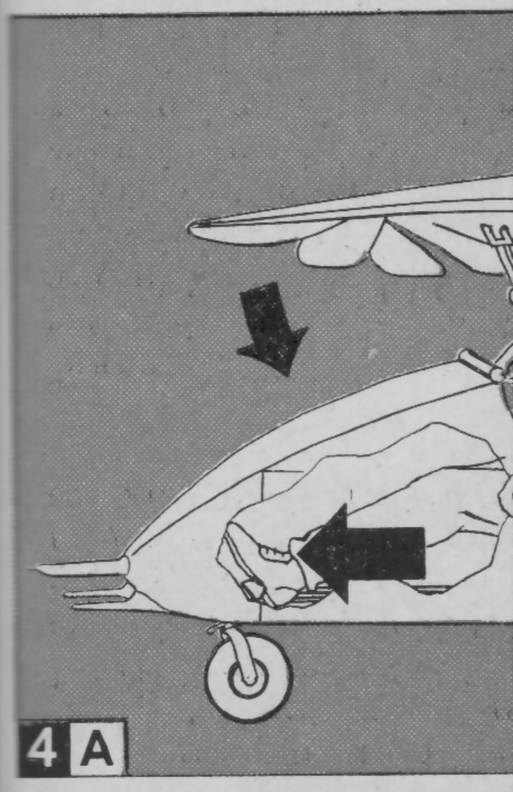
The Man-Powered Aircraft Group of the Royal Aeronautical Society in London has been keeping a close watch on all three projects. *Manpowairg,* as the group is termed, believes the novel planes will be successful—even though previous attempts, dating back to Leonardo da Vinci some 450 years ago, failed.

Manpowairg bases its optimism on the large body of knowledge about flight principles built up in the past 60-odd years. Da Vinci and others, including the legendary Icarus who flew too close to the sun with his waxed and feathered wings, did not have this backlog of experience to draw on. Nor were suitable lightweight materials available for construction.

In addition, studies have been made to determine just how much "horsepower" a man can develop to drive such craft.

Dr. D. R. Wilkie of the department of physiology at University College, London (and a Manpowairg member), says a man can generate enough power so that "practi-





Here's how ornithopter is po Rubber bands are tensioned pilot stretches his

-Coming

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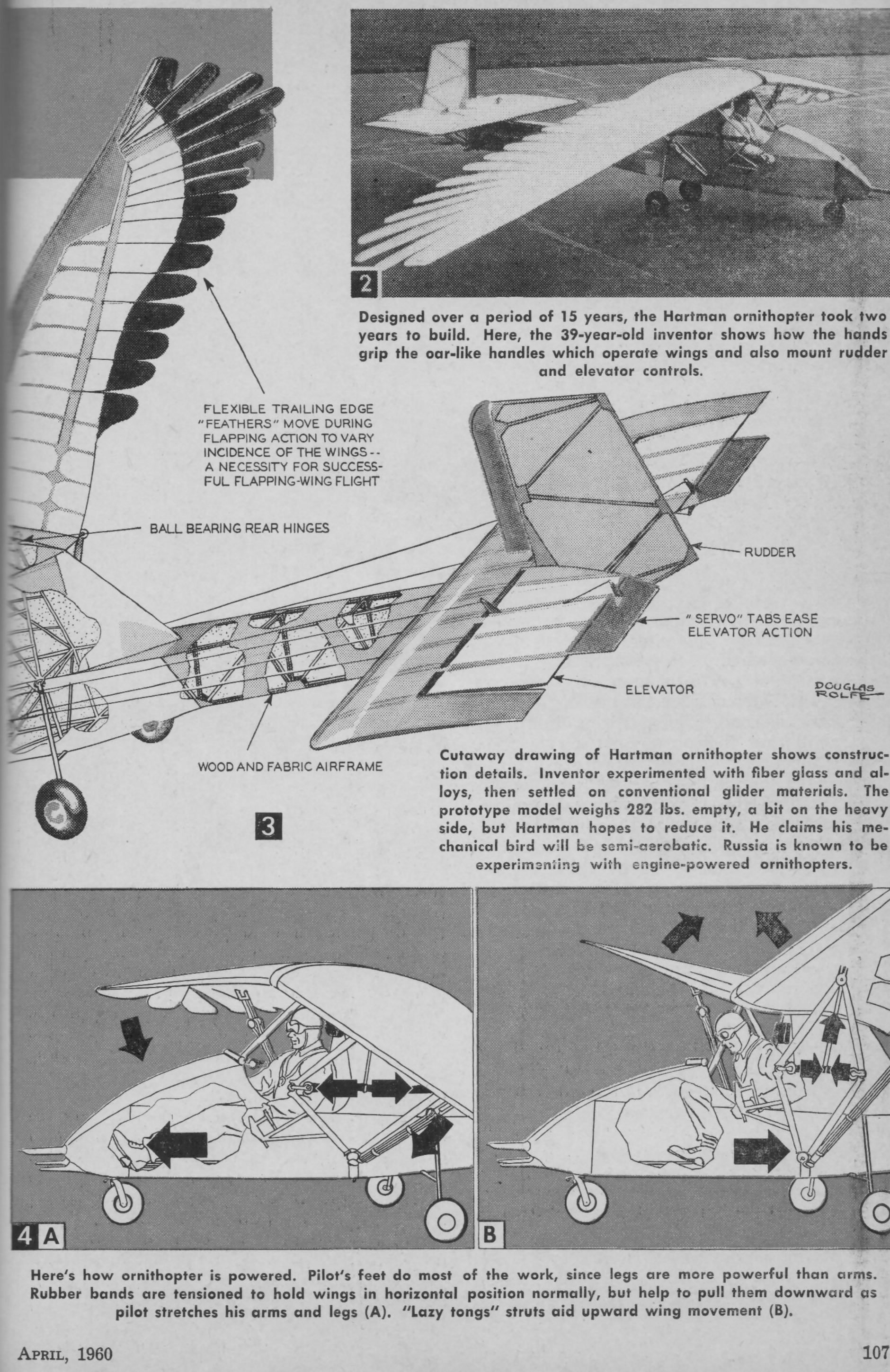
Designed over a period of 15 years, the Hartman ornithopter took two years to build. Here, the 39-year-old inventor shows how the hands grip the oar-like handles which operate wings and also mount rudder and elevator controls.



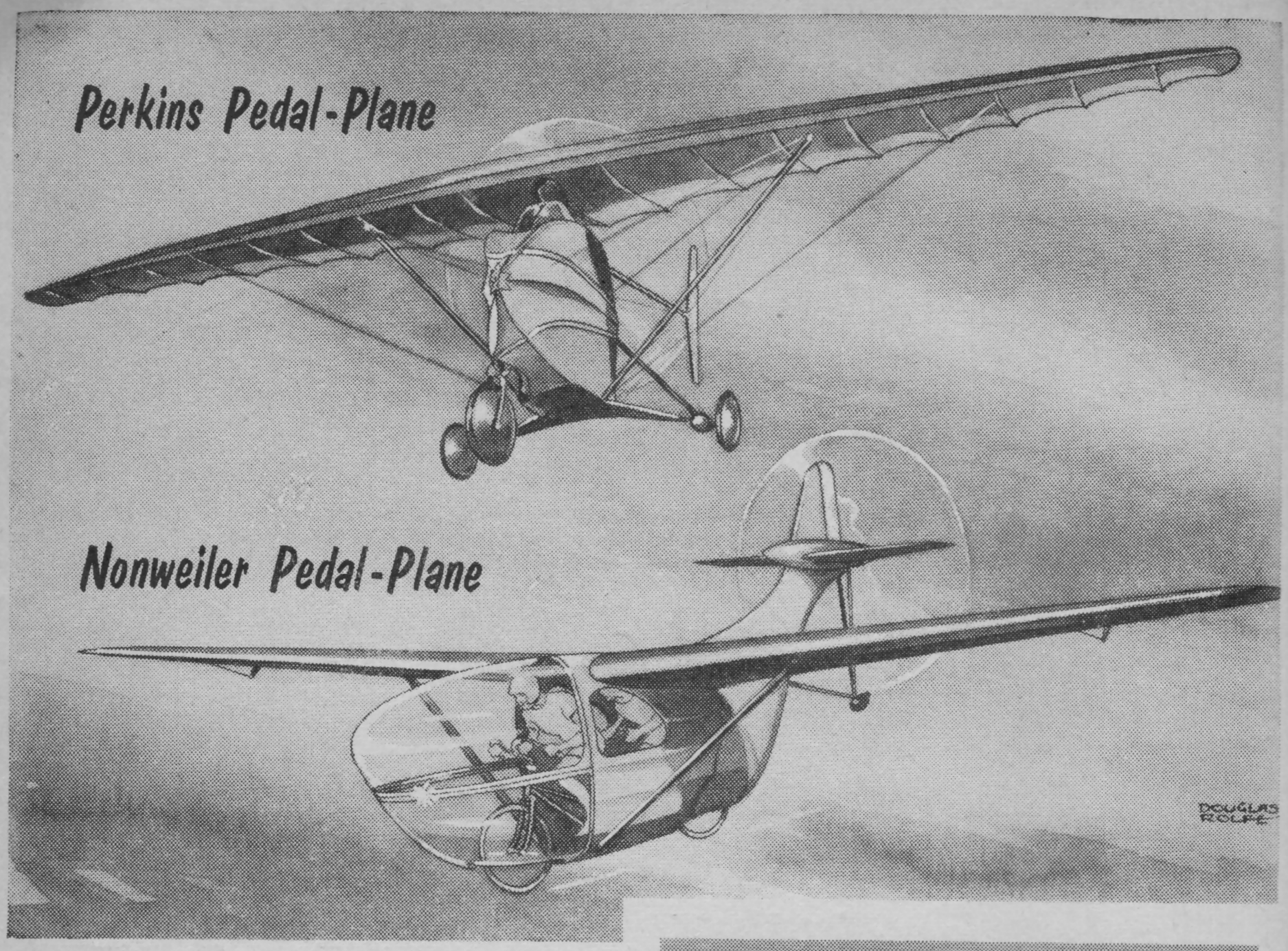
3

Cutaway drawing of Hartman ornithopter shows construction details. Inventor experimented with fiber glass and alloys, then settled on conventional glider materials. The prototype model weighs 282 lbs. empty, a bit on the heavy side, but Hartman hopes to reduce it. He claims his mechanical bird will be semi-aerobatic. Russia is known to be experimenting with engine-powered ornithopters.

4 A

B

Here's how ornithopter is powered. Pilot's feet do most of the work, since legs are more powerful than arms. Rubber bands are tensioned to hold wings in horizontal position normally, but help to pull them downward as pilot stretches his arms and legs (A). "Lazy tongs" struts aid upward wing movement (B).



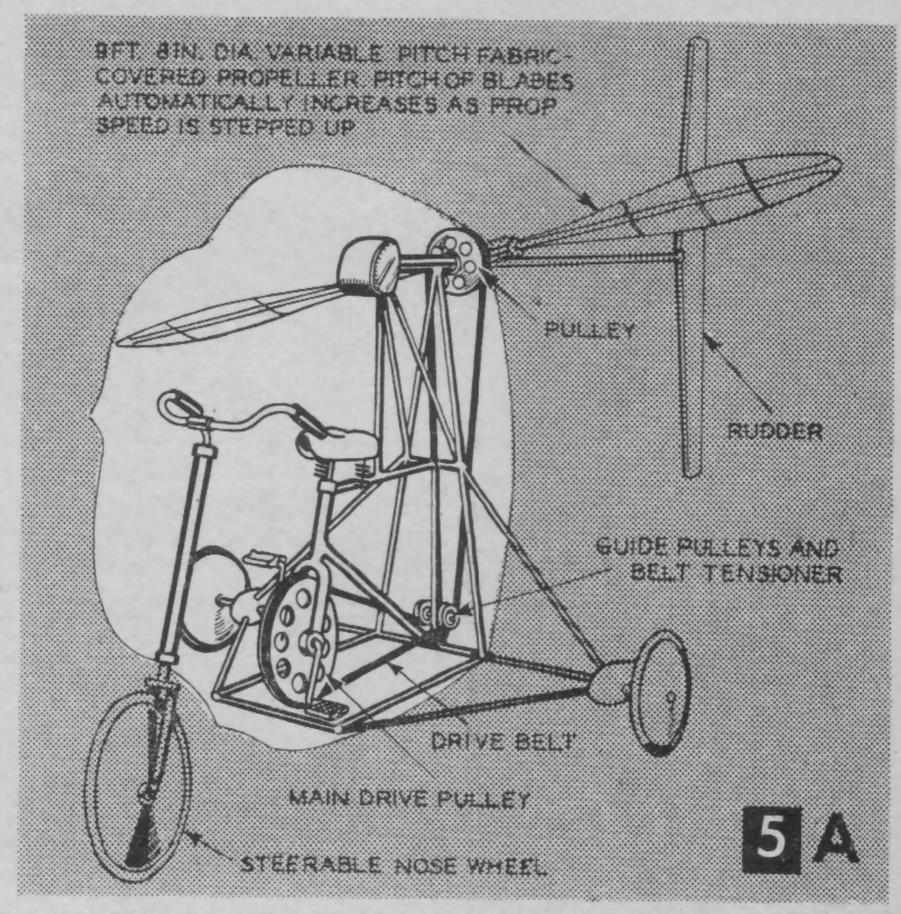
cal man-powered flight is possible."

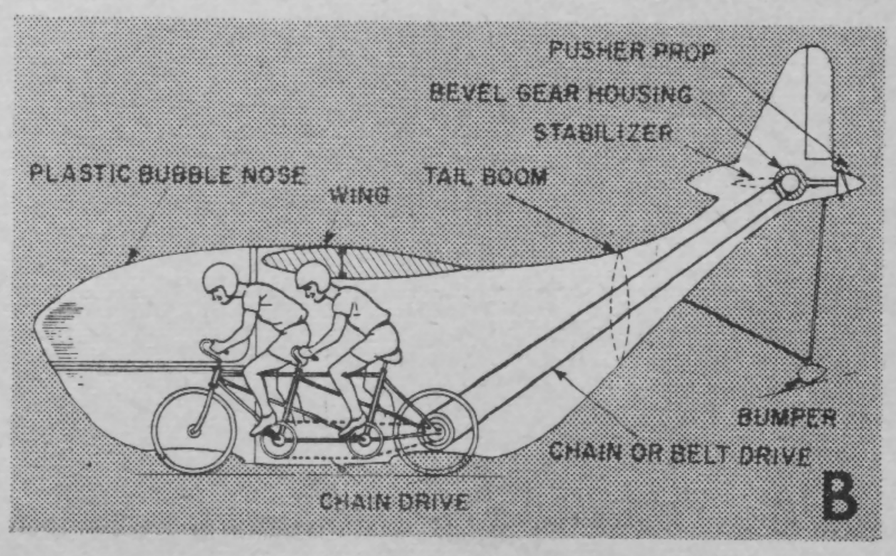
He found that a 175-lb. man can develop about 4/10 horsepower for five to 30 minutes at such tasks as rowing, bicycling or climbing.

By calculating the power needed to fly, using as his basis the great bustard bird which weighs about 30 lbs., Dr. Wilkie showed on a graph that the 4/10 horsepower should be sufficient for a man to fly. It should also be noted that the wing-flapper being tested (see Figs. 1-4) is designed so rubber bands and "lazy tongs" supplement the pilot's muscles.

The two-man pedal-plane (see Fig. 5B) is being built by a team of enthusiasts headed by T. R. F. Nonweiler, senior lecturer in aeronautical engineering at Queen's University of Dublin, Ireland. It echoes Dr. Wilkie's belief that wings built for two men probably are more immediately practical.

The other pedal-prop plane is a venture by Daniel Perkins, an experimental officer with the Cardington Balloon Research Station of the British Ministry of Aviation.





Simple drive gear of Perkins aircraft (A) converts pedal power into prop rotation. The plane has an inflated, 40-ft. rubber wing and weighs only 74 lbs. Pilot moves wings for longitudinal and lateral control. Nonweiler pedalcraft (B) applies power to rear wheel in addition to prop, boosting take-off speed. Wingspan is 60 ft. and empty weight about 150 lbs. Take-off for both craft may be aided by run down long ramp or hill.

Map S

HOW fast will your car, house flashing or steel gutters rust?

With this map you can determine how long a sheet of 28-gage steel exposed to the weather will last in your area before becoming severely rusted. It shows that in such cities as Miami, Fla., Buffalo, N.Y., or Los Angeles, Calif., uncoated steel will last only three years before becoming severely corroded. Santa Fe, N. M., on the other hand, has an index of 15 plus.

If you live in a high rust-rate area, you'll need to take extra care to protect gutters, downspouts, flashing, machinery or toys by galv

Rust can occur only w oxygen are present on s little rusting occurs in dr when the relative humidi 60% at normal or lower t

Rural areas are less li with rust than cities, wh —which usually contain of sulphur—act together air to hasten rusting.

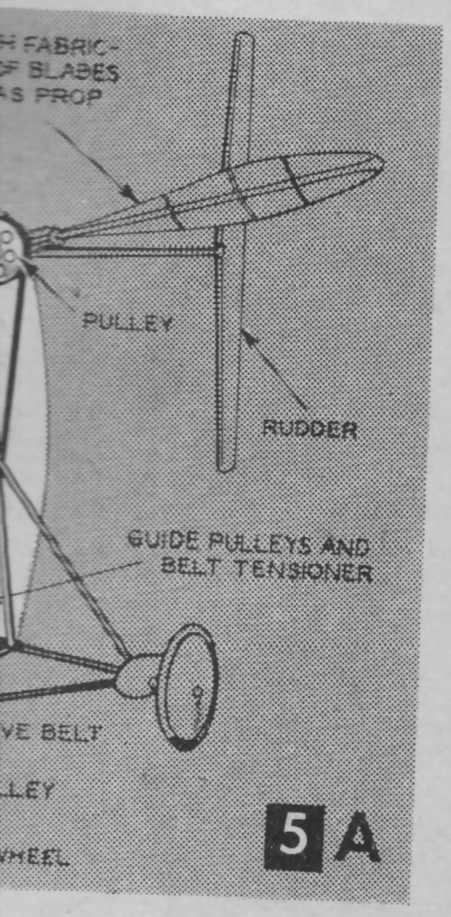
Rust proceeds very slo Southwest, where relati ally below 60% at norma

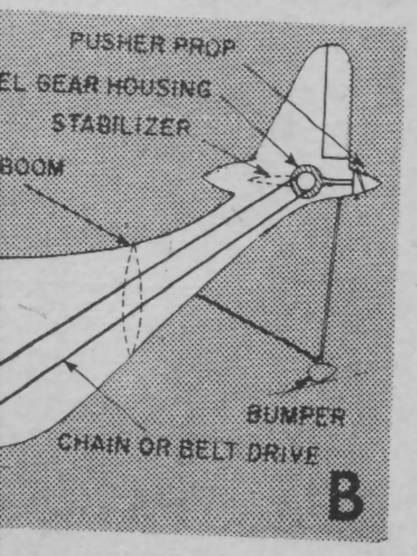
Portable D for Lab

CRITICAL laboratory tions can be perfor conditions in this dust full visibility and free and hands.

A blower at the top the hood through a fi airborne dust particles micron in diameter (a mi of a meter). The air f pressure inside the hood filtered room air from front.

Made by Air-Shields, unit weighs only 35 pou



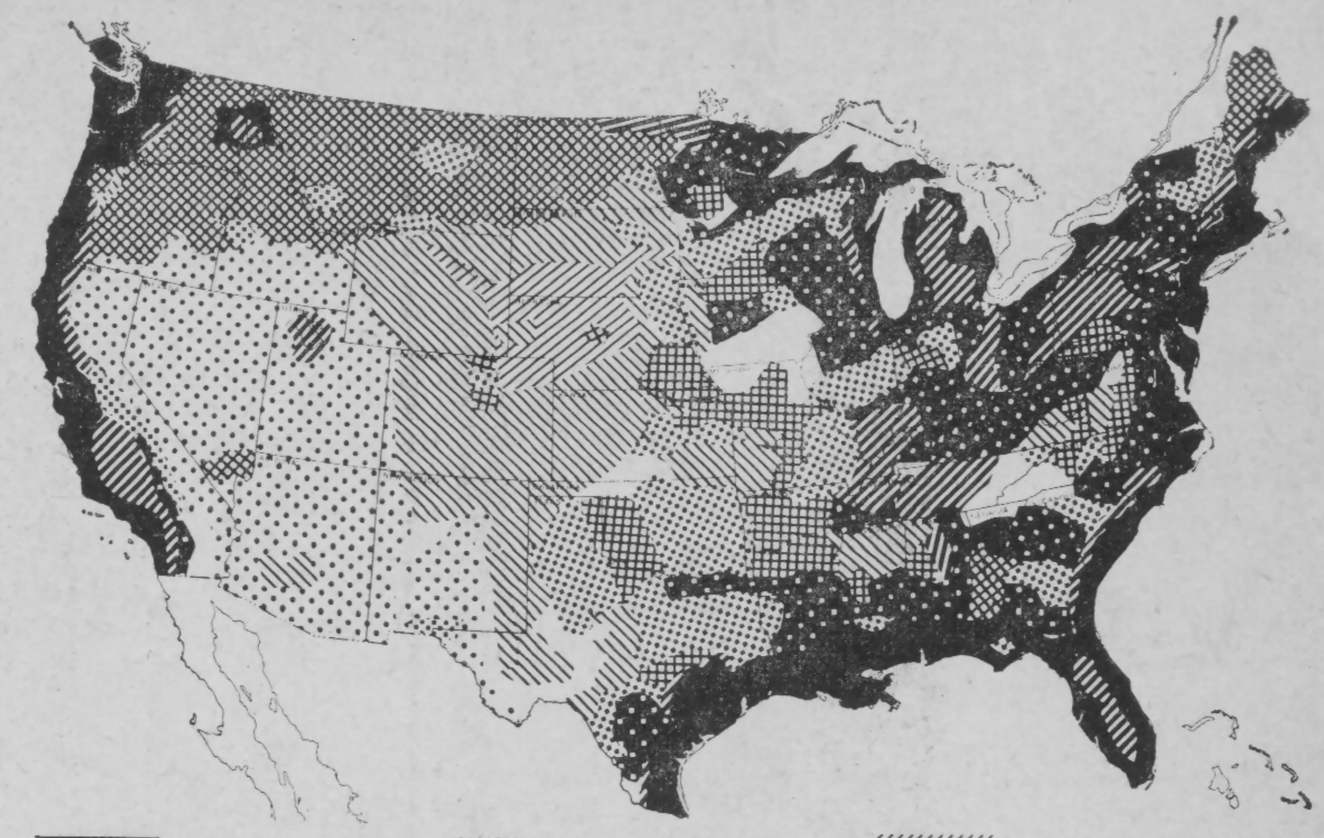


Map Shows Your Area's Rust Rate

HOW fast will your car, house flashing or steel gutters rust?

With this map you can determine how long a sheet of 28-gage steel exposed to the weather will last in your area before becoming severely rusted. It shows that in such cities as Miami, Fla., Buffalo, N. Y., or Los Angeles, Calif., uncoated steel will last only three years before becoming severely corroded. Santa Fe, N. M., on the other hand, has an index of 15 plus.

If you live in a high rust-rate area, you'll need to take extra care to protect gutters, downspouts, flashing, machinery or toys by galvanizing or painting.



Number of years required to severely corrode an uncoated 28-gage steel test panel exposed to outside weather conditions.

Rust can occur only when both water and oxygen are present on steel. For example, little rusting occurs in dry or arid regions or when the relative humidity of the air is below 60% at normal or lower temperatures.

Rural areas are less likely to be troubled with rust than cities, where industrial fumes —which usually contain gaseous compounds of sulphur—act together with moisture in the air to hasten rusting.

Rust proceeds very slowly in the dry, hot Southwest, where relative humidity is usually below 60% at normal temperatures, but rapidly in the damp Gulf and Pacific Coast areas, or marine atmospheres where sea breezes containing small quantities of salt speed up corrosion. Because wind speeds up corrosion by bringing fresh oxygen in contact with steel surfaces, the wind-swept areas around the Great Lakes tend to have high rust rates.

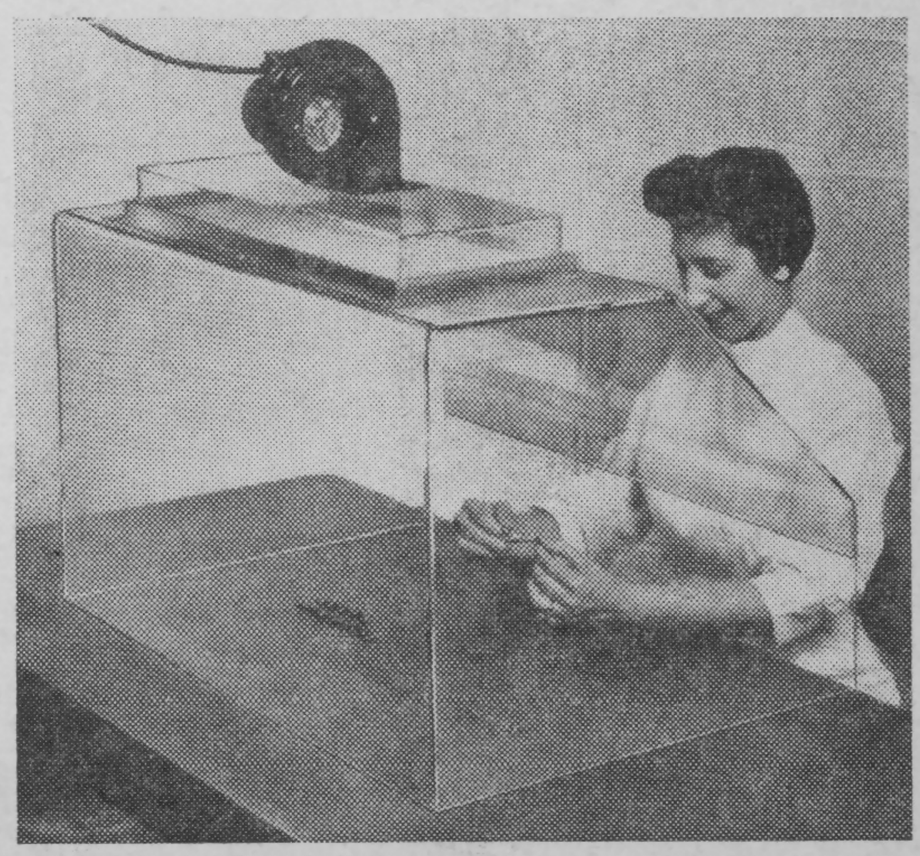
The rust index map was compiled from test panels of steel exposed in all areas of the United States during the past twenty-five years by the Rust-Oleum Manufacturing Company, Evanston, Illinois.—MERLE E. DOWD.

Portable Dust Hood for Lab Work

CRITICAL laboratory or inspection operations can be performed under dust-free conditions in this dust hood—which allows full visibility and free movement of arms and hands.

A blower at the top forces room air into the hood through a filter, which removes airborne dust particles as small as one-half micron in diameter (a micron is one-millionth of a meter). The air flow also provides a pressure inside the hood which prevents unfiltered room air from entering the open front.

Made by Air-Shields, Inc., Hatboro, Pa., the unit weighs only 35 pounds and sells for $285.



MHD Generator Has No Moving Parts

RESEARCH into some of the problems of space travel has led to an experimental electric power generator that has no moving parts and may be 25% more efficient than those now in use.

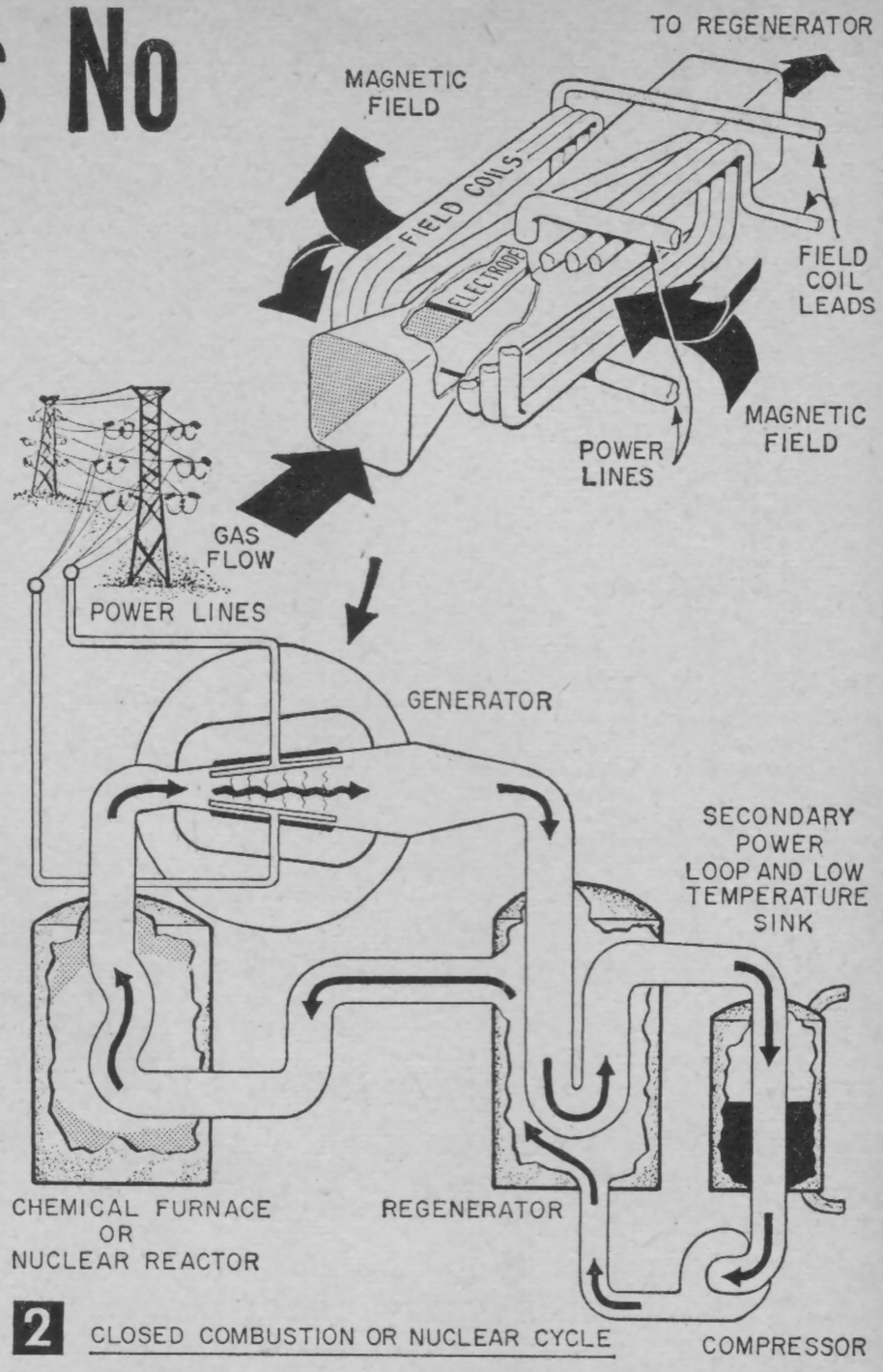
Based on the scientific principle of magnetohydrodynamics (MHD), the new system depends on the fact that an ionized gas passing through a magnetic field will generate electricity (see drawing). It substitutes the super-heated gas for the armature usually found in a generator. Also eliminated in the new system is the costly and heavy steam turbine equipment needed to drive the armature.

A small laboratory MHD generator already has attained 10 *kw* power output—not enough for practical purposes, but enough to indicate that an MHD power plant is feasible.

Two different methods of super-heating the gas to more than 4000°F are being explored. One would use a coal-fired furnace to heat and ionize the gas entering the magnetic field. The other would use a nuclear reactor for the same purpose.

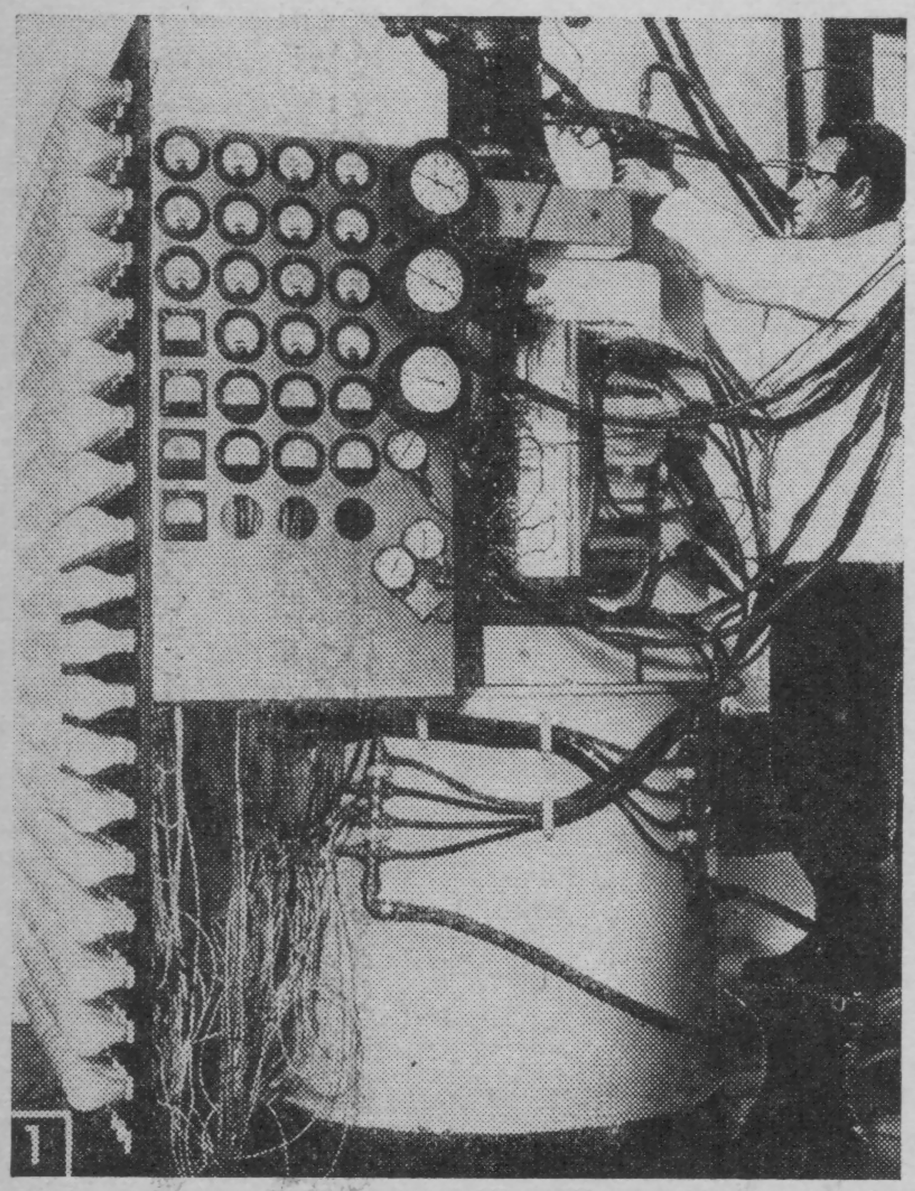
One problem with the coal-type is the heat and chemical reaction between combustion products and structural materials. The nuclear-fueled plant would reduce this problem but it will have to wait until high temperature reactor cores are developed. Happily, recent developments at the Atomic Energy Commission's Project Rover indicate they will be available in the near future.

MHD studies have been conducted for some 10 years by Avco Corp., New York, N. Y., which first started them in connection with space propulsion and re-entry problems. Ten of the nation's large electric power companies are teamed with Avco in the power generator research project.



2 CLOSED COMBUSTION OR NUCLEAR CYCLE

Drawing shows flow of ionized gas through the new MHD power generation system. Furnace or nuclear reactor heats the gas, causing its molecules to "lose" electrons and become electrically charged. The gas then flows through a magnetic field in the generator, where direct current is tapped off by means of electrodes. The gas is then cooled in regenerator and heat sink, compressed and then pre-heated in regenerator prior to re-entering furnace. In coal-fired system, potassium is seeded into combustion gases to increase their conductivity. In nuclear reactor method, argon or helium is laced with cesium.



1

Technician adjusts experimental lab model of MHD generator capable of more than 10 *kw* output. Gas will be heated by electric arc at top of machine, then pass downward through magnetic field where current will be induced, lighting the bulbs at left.

How the V Performanc

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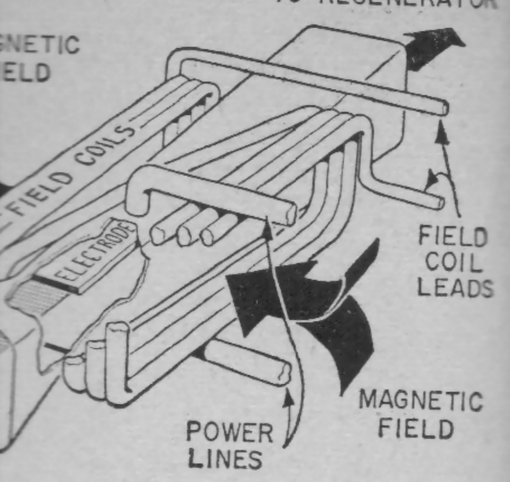
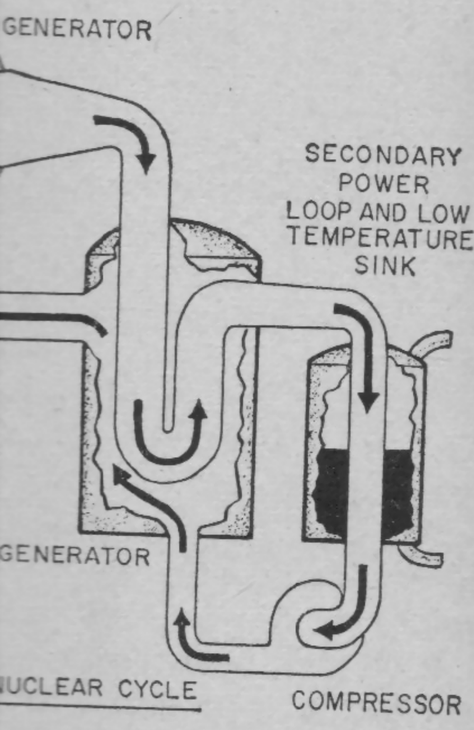
	Top Speed (MPH True)
Valiant (manual trans.)	89.6
Falcon (manual trans.)	82.6
Corvair (auto. trans.)	82.0





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been conducted for co Corp., New York, ed them in connection nd re-entry problems. e electric power com- h Avco in the power ject.

Coming or going, Valiant cuts a sporty caper. Dual head lamps and the grille are integrated by the sculptured hood and fender lines. The deck lid is large, with a simulated wheel cover stamped into it.

How the VALIANT's Performance Compares

THE new Valiant was evidently designed with one eye on the superhighways and the other on style.

It is a fast car, probably the fastest small sedan on the road. It is a quality car, without a hint of cost-cutting in its decor and general design.

From the speed standpoint, note the following:

	Top Speed (MPH True)	Acceleration (0-60 True MPH . in Sec.)
Valiant (manual trans.)	89.6	14.1
Falcon (manual trans.)	82.6	21.0
Corvair (auto. trans.)	82.0	22.1

The top speed of 89.6 *mph* compared to the 82 to 83 *mph* of the other new compacts is a much greater superhighway potential factor than it at first appears. Many superhighways have a speed limit of 70 *mph*—and a 75 *mph* limit is probably not too far in the future.

For driving at the speed limit, it is desirable *not* to have your foot to the floor, so the engine will not be operating at full capacity and the carburetor power jets will not be fully opened. This leaves a power reserve for passing and provides better fuel economy.

What About Slower Speeds? On the other hand, at more usual speeds Valiant pays for its sparkling performance with lower fuel economy. Its overall fuel consumption—a combination of level-road driving, heavy traffic and medium traffic—is 18.3 *mpg* (our test car had a 3.55 rear axle and manual transmission). Corvair—also with a 3.55 axle but automatic transmission—hits an overall figure of 17.5 *mpg*, and Falcon measures in at 22.7 *mpg* with its 3.10 axle and stick shift.

Actually, the American compacts are not "economy" cars. If you are looking for real fuel economy, the small foreign car is su-

Valiant V-200 4-door Sedan

MODEL: Valiant V-200 4-door Sedan.

TEST DATES: Nov. 23, 1959 through Nov. 30, 1959.

GENERAL ROAD AND WEATHER CONDITIONS: Portland concrete, generally smooth and level; cold winter days, 20-30°F; 29.2 to 29.6 in. Hg.

MILEAGE AT START: 1660.

MILES COVERED: 695.

GAS: Regular. **OIL:** SAE 20W.

CURB WEIGHT (with 10 gal gas): 2880 lb; 55% on front wheels; 45% on rear wheels.

TIRE PRESSURE: 24 psi front; 24 psi rear.

SPARK SETTING: 5° BTC at 500 rpm.

REAR AXLE GEAR RATIO: 3.55 to 1.

TRANSMISSION: Manual; 2.71:1 in 1st; 1.83:1 in 2nd; direct in third; 3.49:1 in reverse.

TEST DATA

GASOLINE MILEAGE (checked with fuel volume flow meter and 5th wheel. Temperature 25°F; relative humidity 50%; barometer 29.3 in. Hg.)

LEVEL ROAD FUEL CONSUMPTION (carried weight 430 lb. Average of two or more runs made in opposite directions over same road.):

True MPH	20	30	40	50	60	70
True MPG	31.0	28.5	24.6	21.8	20.0	18.6
True Ton MPG	51.2	47.1	40.7	36.0	33.1	30.8

TRAFFIC FUEL CONSUMPTION (carried weight 460 lb): Simulated traffic pattern of city driving—stops, acceleration, braking, at speeds primarily of 30 and 45 mph:

True MPG	True Ton MPG	True Average MPH
18.3	30.5	23.9

CITY-COUNTRY FUEL CONSUMPTION (miles covered on 5 gal. gas on course combining open road (country) and slower traffic (city) driving, at speeds of 30, 40, 50 and 60 mph):

True Mileage	True MPG	True Average MPH
111.5	22.3	33.5

OVERALL FUEL AND OIL consumed during test, including idling, warmups and all-weather driving:

Total Mileage	Total Gal Fuel	Total Oil	True MPG	Oil MPQ
695	38.0	1 qt.	18.3	700

OVERALL EFFICIENCY to move car's mass against road friction and air resistance, calculated from level road mph, weight, and frontal area of car: 12% at 30 mph; 16.6% at 60 mph.

ACCELERATION—LEVEL ROAD (timed with 5th wheel; carried weight 400 lb; Temperature 31°F; relative humidity 70%; barometer 29.8 in. Hg; average of two or more runs in opposite directions over same road):

MPH (True)	0-20	0-30	0-40	0-50	0-60	0-80	20-40	20-60
Time (sec)	3.12	5.04	7.92	11.2	14.1	23.4	9.18	19.9

GEAR SHIFT PATTERN: Standing start to 38 mph in 1st gear; 38 to 58 mph in 2nd; then hi-gear to speed indicated; 20-40 and 20-60 mph from steady 20 mph to speed indicated in hi-gear.

QUARTER MILE SPRINT from standstill: 67 mph (true) in 20.4 sec.

MINIMUM ACCELERATION time for 0-60 mph (true) over level road with no wind, best spark setting, reg. fuel and driver alone: 12.3 seconds.

ACCELERATION FACTORS:

True MPH	Gear	MPH/sec	Ft/sec²
10	Lo	6.5	9.5
20	Lo	5.5	8.1
30	Lo	4.5	6.6
50	2nd	3.0	4.4
60	3rd	2.0	2.9

HILL CLIMBING AND DRAWBAR PULL (calculated from acceleration data with allowances made for rotational inertia):

Approx. MPH	Gear	Grade %	Pull in lb.
30	2nd	19.7	640
60	Hi	7.6	250

SPEEDOMETER-ODOMETER CORRECTIONS: For 10 true miles traveled at 40 mph odometer registers 10.02 miles. For 10,000 true miles traveled, odometer will register 10,020 miles. Multiplication factor and % of error 0.998 and neg. %.

Speedometer MPH	True MPH	Engine RPM	Speedometer MPH	True MPH	Engine RPM
95	89.6	4460	50	48.8	2460
90	85.4	4240	40	39.5	2000
80	76.5	3800	30	30.0	1530
70	67.8	3400	20	19.8	1000
60	58.5	2950	10	9.9	520

LONGITUDINAL DIP ON BRAKING: At a steady deceleration rate of 21 ft/sec², body nose diving angle was 2°.

PARKING BRAKE TEST: When brake was applied hard and suddenly from 20 mph true speed, car braking distance was 57 ft. Left wheel did not lock; right wheel did not lock.

CHASSIS DYNAMOMETER HORSEPOWER (tests made by Clark Automotive Service, Chicago): Temperature 60°F; relative humidity 60%; barometer 29.4 in. Hg.

MPH True	Engine RPM	Horsepower
40	2000	39
60	3000	55
74	3700	61

HORSEPOWER AT REAR AXLE (values calculated from acceleration data with allowances made for efficiencies and rotational inertia):

MPH True	Engine RPM	Equiv. Engine Torque (lb. ft.)	Axle Horsepower
40	2000	118	45
60	3000	110	63
76	3800	94	68

Per cent of advertised engine horsepower (101) to rear wheels: 67%.

ESTIMATED ANNUAL GASOLINE COSTS: $175.00 for 10,000 miles (using regular gas at 32¢ a gallon).

CALCULATED PERFORMANCE FACTORS

True MPH at speed of max. advertised HP	88
True MPH at speed of max. advertised torque	48
Engine rpm at 60 mph (also rev. per mile)*	3020
Average piston speed at 60 mph (also ft/mile)*	1575
Cu. ft. per minute of mixture at 60 mph (also cu. ft/mile)—a theoretical measure of fuel economy—low values desirable	148
Max. engine HP (adv) per ton of car (curb wt.)—a theoretical measure of acceleration performance—high values desirable	70.2
Max. engine HP (adv) per cu. in. displacement—a measure of design excellence in producing power-high values desirable	0.595
Power performance factor (a weighted average of CR, displacement and curb wt.). This is a theoretical measure of potential acceleration	75.4
Reciprocating load factor at 60 mph (based on piston weight, bore, stroke, rpm)*	1570

* Lower values indicate less wear and stress on the engine.

CERTIFICATION

I certify that the test results in this report are the actual findings obtained in tests, conducted in accordance with good engineering practice, on the automobile named and under the conditions specified.

Edw J Chert

Member, Society of Automotive Engineers, American Society of Mechanical Engineers, Director, Automotive Research Laboratories, Professional Engineering Consultants.

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Valiant's curb weight is 2880, Falcon's is 2375 and Corvair's 2470. The Opel Rekord, on the other hand, weighing 1975, gets 30.4 *mpg* overall. Our 1958 test on the Simca Aronde—a Chrysler import—gave a 23.6 *mpg* figure (weight was 2100 lbs.). The tiny Fiat weighs only 1325 lbs. and gives 35.6 *mpg*.

These figures show conclusively that Detroit has decided the American compact should be a compromise between European economy and American performance.

Valiant Can Crow about several things, relative to its American competitors. We would suggest first, its swift performance and, second, its elegant styling, for those sold on sculpturing.

The 6-cylinder engine, on its side (30° incline), is a new design that hints of lower hood lines to come.

Another excellent innovation is the use of a generator which produces a-c instead of the d-c found in most cars. The output from the "alternator" is then changed into d-c to charge the battery. The advantage? It works even at idling speed, so that the battery stays charged even on short trips.

Other features are torsion bars in front with leaf springs in the rear. Along with the car's heavier weight they help give Valiant a soft, comfortable rid

or Sedan

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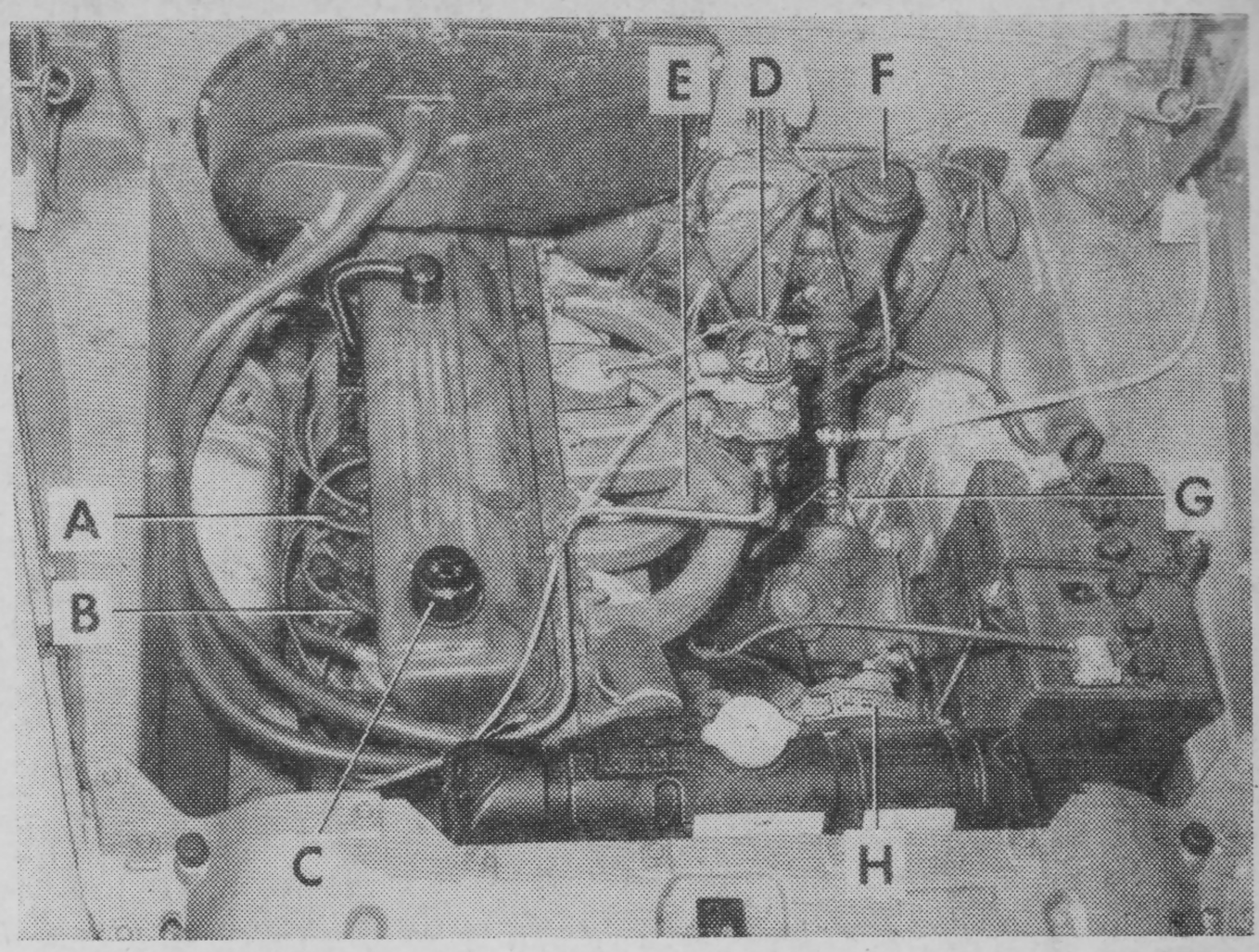


Here is Valiant's engine-on-its-side. A prime advantage of this design is that you can build the hood lower. Note (A) Distributor; (B) Spark plugs; (C) Oil fill; (D) Single-barrel carburetor; (E) Streamlined manifold; (F) Brake fill; (G) Dip stick and (H) Alternator generator.

TEST CAR MEASUREMENTS and SPECIFICATIONS

MAKE & MODEL	Engine Type	No. of cyl.	Adv. Max. Brake HP @ rpm	Adv. Max. Torque lb ft @ rpm	Mean Effec. Pressure lb/in² @ rpm	CR	Piston Displ. (cu. in.)	Fuel Spec.	Curb Wt. (lbs.) with 10 gal. gas oil and water
Valiant V-200	In-line	6	101 @ 4400	155 @ 2400	137 @ 2400	8.5	170	reg.	2880

Trans-mission Type	Rear Axle Ratio	Opt. Axle Ratio OD	Opt. Axle Ratio Man. or Auto.	Turning Circle (ft.)	O.A. Steering Ratio Man.	O.A. Steering Ratio Pow.	Steering Torque to turn (lb. ft.) (man.)	No. turns Man. (lk-lk)
Manual	3.55	None	3.23	37.1	23.8	18.7	6	5.25

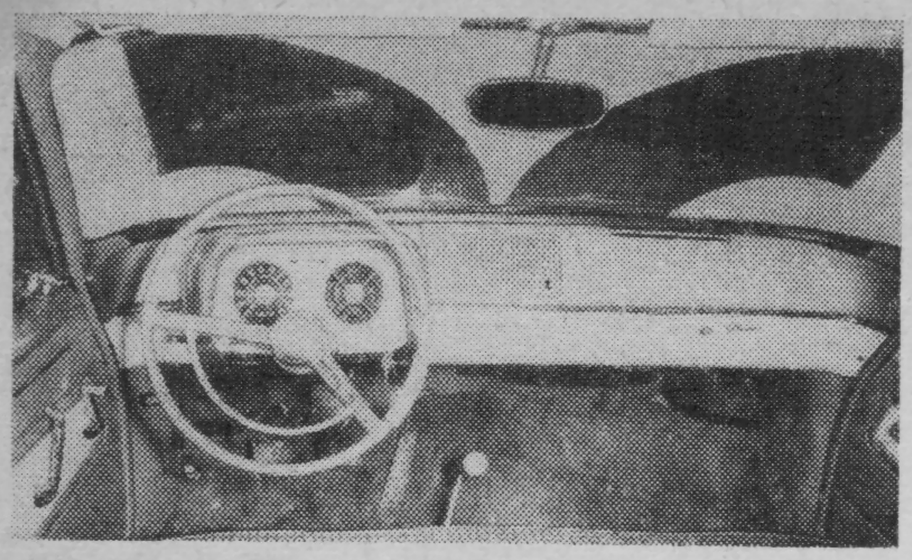
Wheelbase (in.)	O.A. Length (in.)	O.A. Width (in.)	O.A. Height (in.)	Min. Ground Clearance (in.)	Worst Bump Can Clear radius (ft.)	Worst Dip Can Cross radius (ft.)
106.5	183	68.75	55.25	6.5	19.5	25

Max. Driveway Angle Car will Clear	Highest Curb Doors will Clear (in.) Front	Highest Curb Doors will Clear (in.) Rear	Highest Curb Bumper will Clear (in.)	Overhang (in.) Front	Overhang (in.) Rear	Door Width opening clearance (in.) Front	Door Width opening clearance (in.) Rear
20°	14.75	16	11	28.75	47.75	53	52.5

Headroom Front	Headroom Rear	Front Legroom	Rear Kneeroom	Rear Seat Depth	Hiproom Front	Hiproom Rear	Seat Height Front	Seat Height Rear	Shoulder Room Front	Shoulder Room Rear
34	33	42	8 to 11.5	19.5	51	50.5	12.75	13.5	53	52.5

Max. Seat Travel Lat.	Max. Seat Travel Vert.	Vision Areas (sq. in.) Wind-shield	Vision Areas (sq. in.) Rear Window	Driver's Eye-to-Road Distance Left	Center	Right	Tires Size	Tires Ply	Battery
3.75	0.5	988	976	22'0"	27'7"	26'4"	6.50x13	4	12 volt 50 AH

Gas Tank (gals.)	Oil Fill (qts.)	Rad. Cap. (qts.)	Trans. Cap. (pts.)	Trunk Dimensions (in.)	Luggage Lifting Height	Tire-to-Bumper Front	Tire-to-Bumper Rear
13	4	14	5	52.5 deep x 64.75 wide; 20 tapering to 6 high	24.75	28.25	47.34

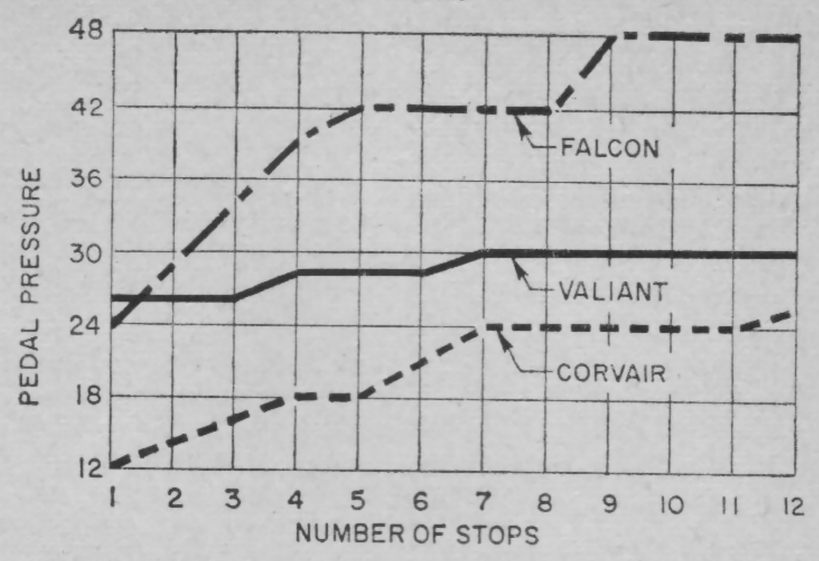


Valiant's instrument panel is well laid out for convenience and visibility. Unlike Corvair and Falcon, it has clap-hand windshield wipers which could do a better job of cleaning side areas. Fairly large unwiped section to the left makes it a bit hard to see pedestrians when turning left at an intersection.

—with a weightier "feel" than Corvair's or Falcon's. Valiant is not easy to bottom, though, and eats the small bumps far better than the run of small imports do.

Valiant's brakes feel a bit soft, but do a good job of stopping, with not much nose dip. And—unlike its American competitor's—Valiant's brakes showed very little fade.

Brake fade figures based on repeated applications of brakes at deceleration rate of 7 ft/sec^2 were as follows:



Valiant's sway on corners is not very noticeable inside the car, despite the 3½° we measured at a steady 40 *mph* on our 285-ft. radius test circle. That's as much lean as we found with Falcon and 1° less than Corvair's, but it was more noticeable inside Falcon.

Shift action is easy and sure, although 2nd gear is a fairly long reach for a short driver. The location of the shift lever, combined with

TECH TALK

The fuel economy of a car is governed by many factors, principally:

- **Frontal area, streamlining and weight.**
- **Rear-axle ratio.**
- **Engine displacement.**
- **Compression ratio.**

Since frontal area and the drag of the streamlining are open to interpretation, let us compare the Big 4 compacts on the other factors—and include our index of fuel economy, the cubic feet per minute of mixture at 60 *mph* (low values are desirable).

	Valiant (manual trans.)	1958 American (manual trans.)	Corvair (auto trans.)	Falcon (manual trans.)
Weight (lbs.)	2880	2600	2470	2375
Rear axle	3.55	2.88 (OD)	3.55	3.1
Displacement cu. in.)	170	195.6	140	144.3
Comp. Ratio	8.5	8	8	8.7
CFM at 60 mph	148	128	126	115

Weight is not an important variable for constant speed driving (but very important when the car is accelerated; hence its effect on fuel enonomy is emphasized in our Traffic Tests).

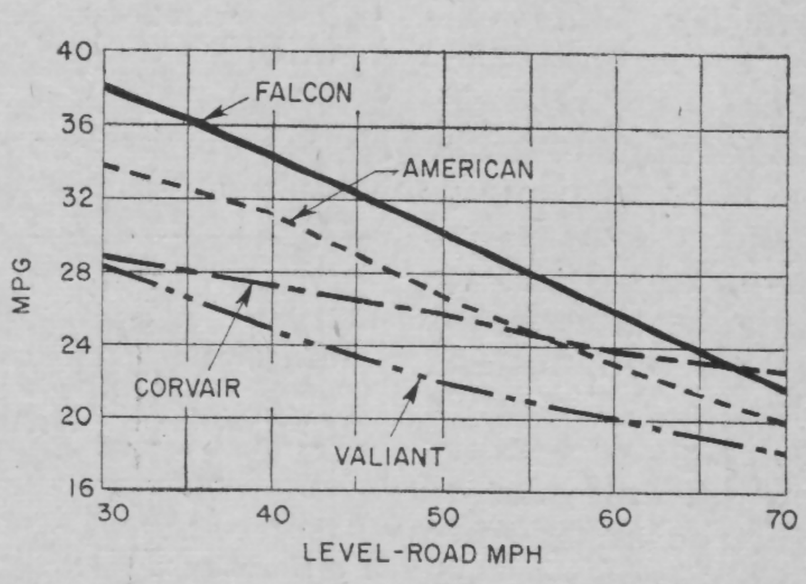
Compression ratio is fairly important, and here the nod goes to Falcon (8.7) and Valiant (8.5).

But the most important variables are rear-axle ratio and, somewhat less, displacement. These two factors are combined in our CFM at 60 *mph* figure (although computed for 60 *mph,* the relative values are unchanged for *any* speed).

Note that Falcon had the best fuel economy because of its small displacement and low-numbered rear axle, which gave a CFM of 115. The Rambler American, although penalized by a big displacement, overcomes this disadvantage by using overdrive to give a CFM of 128 (overdrive is not offered by the other compacts).

Corvair's fuel economy is disappointing at low to medium speeds, probably because of its two-carburetor design, which requires precise adjustment. Although our test Corvair had an automatic transmission, this is not too important since its efficiency is quite high with level-road driving. That the Valiant had the poorest fuel economy is not surprising, since its CFM of 148 is the highest of the four.

Note from the graph that the influence of axle ratio and displacement diminishes with speed, and at around 70 *mph* all curves are coming together (but the low-number rear axles also give lower engine speeds, hence less racket and wear):



Valiant, with its bigger engine and higher top speed, probably does not open its power jet until after 70 *mph,* so we predict that after 80 *mph* it could well have the best fuel economy (if anybody really cares at that speed). However, the primary purpose of this Tech Talk is to emphasize that when driving at superhighway speeds, the relative differences between the compacts' fuel economy tend to disappear. Since displacements are fixed, those interested in fuel economy should buy the lowest-number rear axle available.

Driver's Obs

ROADABILITY: Rear end not
sharp corners and slick surfa
ate. Wind wander hardly no

RIDING AND DRIVING CO
able; softer than other new
very low. Body noise slight
is noisy. Rear end howls
Short driver can see easily o
raps under heavy loads at
spark setting and regular g
tray, something of a reach
compartment. Annoying win
of down stroke.

INSTRUMENTS AND CONT
laid out, easily visible thro
dows open easily. Electri
windshield wipers. Glove com
key). Separate cowl vents
Hood has exterior release c
safety notch. Push-buttons

MISCELLANEOUS: Ash tra
Tire jack okay. Engine fa
pared with V-8s, but not as
vair's because of its incli
distributor, oil filter and spa
accessible. Oncoming head
light image in windshield.
blue. Two-tiered parcel shel
handy. Front end of vent
a bit tricky; leaked under
Trunk leaked badly on one
gage to get at the spare tire
modest. Upper corner of
sharp point, which you m
you get in quickly. Have
operated parking brake; t
scuffs the side material.

driveshaft hump and a
makes three in the fro
though two can sit com

Corvair must get the
handling of the three

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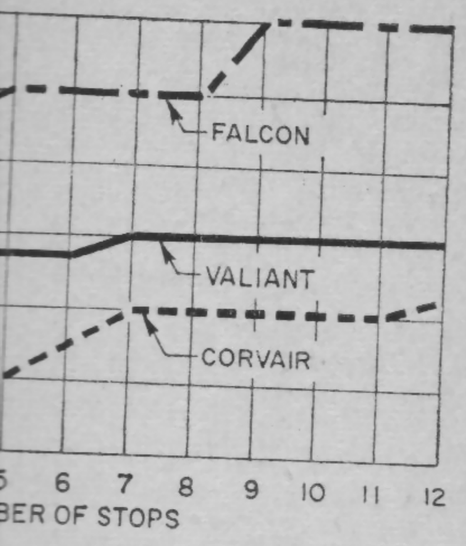

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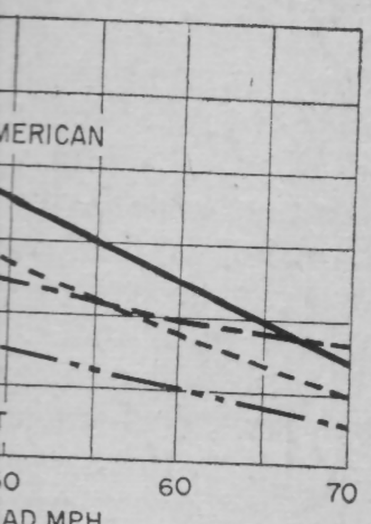

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Driver's Observations

ROADABILITY: Rear end not even a trifle nervous on sharp corners and slick surfaces. Road throb moderate. Wind wander hardly noticeable.

RIDING AND DRIVING COMFORT: Seats comfortable; softer than other new compacts. Noise level very low. Body noise slight, but heater high blower is noisy. Rear end howls softly at about 60 *mph*. Short driver can see easily over steering wheel. Engine raps under heavy loads at low speeds with factory spark setting and regular gas. Lighter is inside ash tray, something of a reach for the driver, as is glove compartment. Annoying windshield wiper slap at end of down stroke.

INSTRUMENTS AND CONTROLS: Instruments nicely laid out, easily visible through steering wheel. Windows open easily. Electric, one-speed, clap-hands windshield wipers. Glove compartment has lock (trunk key). Separate cowl vents for driver and passengers. Hood has exterior release control only, and latch has safety notch. Push-buttons for heat and defrost.

MISCELLANEOUS: Ash tray in back of front seat. Tire jack okay. Engine fairly easy to service, compared with V-8s, but not as easy as Falcon's or Corvair's because of its incline, which tends to hide distributor, oil filter and spark plugs. Dip sticks very accessible. Oncoming headlights produce secondary light image in windshield. Dash lighting a pleasant blue. Two-tiered parcel shelf behind rear seat not very handy. Front end of vent window pulls in to open, a bit tricky; leaked under heavy simulated rainfall. Trunk leaked badly on one side. Have to remove luggage to get at the spare tire. Heater output somewhat modest. Upper corner of front door frame comes to sharp point, which you may hit with your chest if you get in quickly. Have to step high to push foot-operated parking brake; tendency to push sideways scuffs the side material.

driveshaft hump and arm rests on the doors, makes three in the front seat a nuisance, although two can sit comfortably.

Corvair must get the nod for the sportiest handling of the three new American compacts. Valiant's steering is fairly slow, probably because of its greater weight, since its overall steering ratio of 23.8 comes close to the 23.5 of Corvair.

Suggested factory list price for the V-200 4-door sedan is $1946. If you are really flush, you might want to look at the optional power brakes and steering, push-button radio, variable-speed windshield wipers, tinted glass (a good idea because of the high windshield), padded instrument panel, back-up lights and other do-dads. Factory list prices of course do not include taxes and transportation costs.

Roomy (29.4 cu. ft.) trunk, biggest of the three new compacts. The spare tire is under the plywood floor section. Also note the long stem to the gas tank at left.

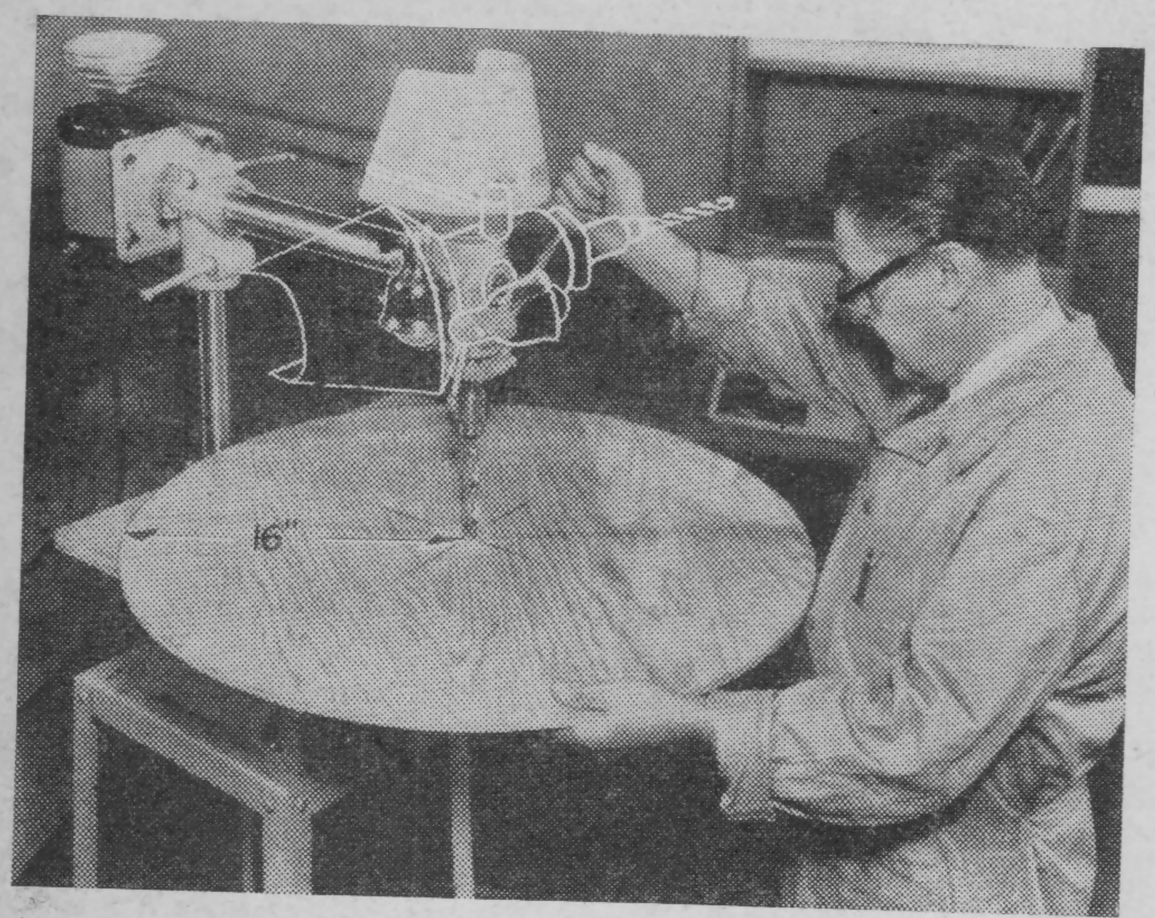
Robot "Stethoscope" Gives Jets Pre-Flight Checkup

FIGHTER pilots can give their supersonic jet planes a complete electronic checkup in 60 seconds with this robot "stethoscope."

The job is done by an electronic system dubbed RADFAC—Radiating Facility for Aircraft Flight Line Testing. Upon a signal from the pilot, using a remote control unit, RADFAC runs a check on the plane's communication, identification and navigation systems. It advises him—verbally or by tone signals—whether they are in good working order. If anything is wrong, it pinpoints the trouble.

The gear is housed in a trailer, which can be parked as far as two miles away and still function effectively. All planes within the unit's operational radius can be checked out simultaneously, if necessary. RADFAC is built by Republic Aviation Corp., Farmingdale, L. I., N. Y.

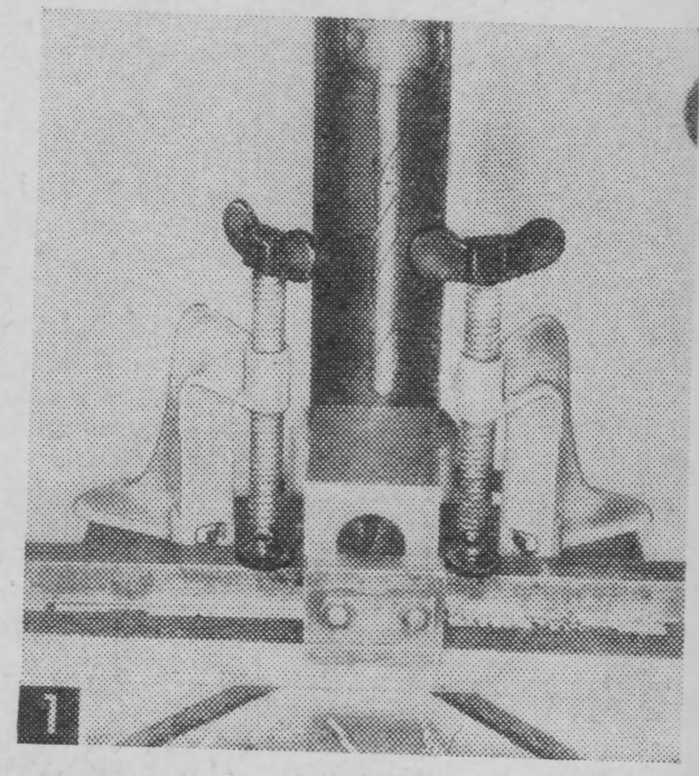
Toil Savers for Workshoppers



↑ **Radial Drill Press has 16-in. Throat Capacity,** is adaptable to all types of drilling. Head tilts and swivels on the supporting column so the drill bit is positioned. Work remains supported on the 24 by 16-in. table mounted on a machined table that may be used for metal-working. The $89.50 (without motor) tool operates at speeds of 700, 1250, 2400 and 4700 *rpm*, is made by Delta Power Tools.

Hold-down Clamps work firmly on any surface without being limited to positions near the edge. The No. 16 Jorgensen clamp can be spotted near the edge of the work or fitted into holes or slots in the work table (Fig. 1). Clamp then slips on or off holding-bolt head in seconds without tools. Clamp swivels 360° around the holding-bolt (Fig. 2), has an opening capacity of 3 in. Installed along the edge of the workbench or table, the clamp doubles as a vise. Made by the Adjustable Clamp Co., Dept. HSM-58, 417 No. Ashland Ave., Chicago 22, Ill., the clamp is priced at $2.60 at hardware dealers.

↓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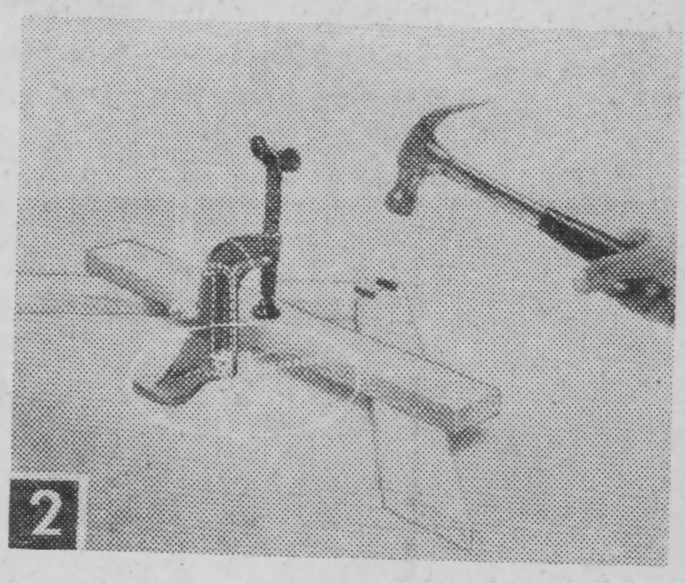
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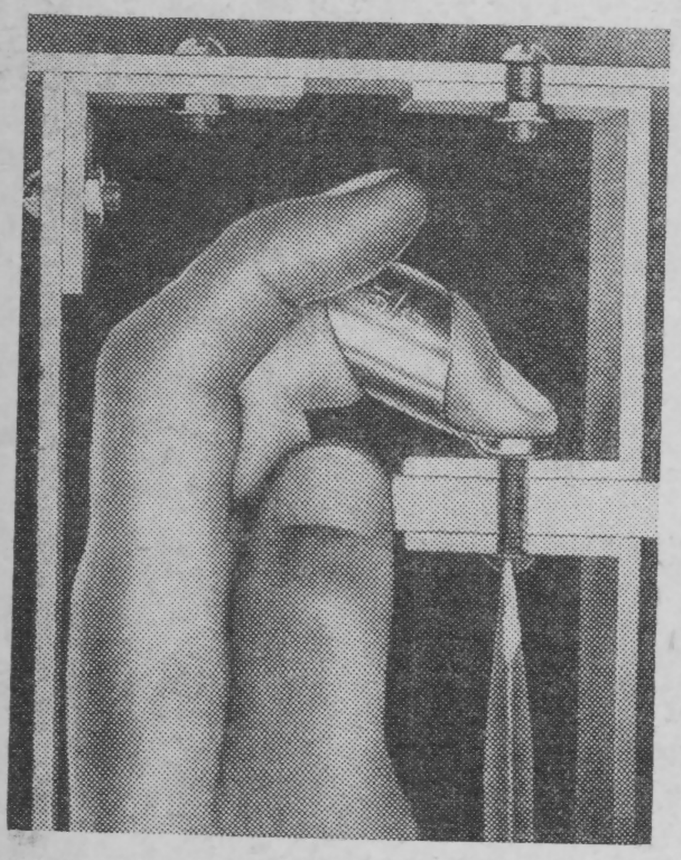
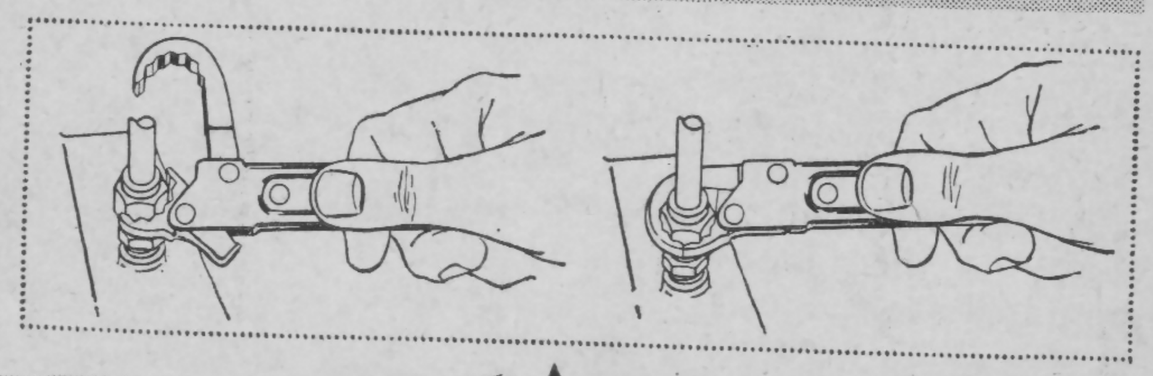
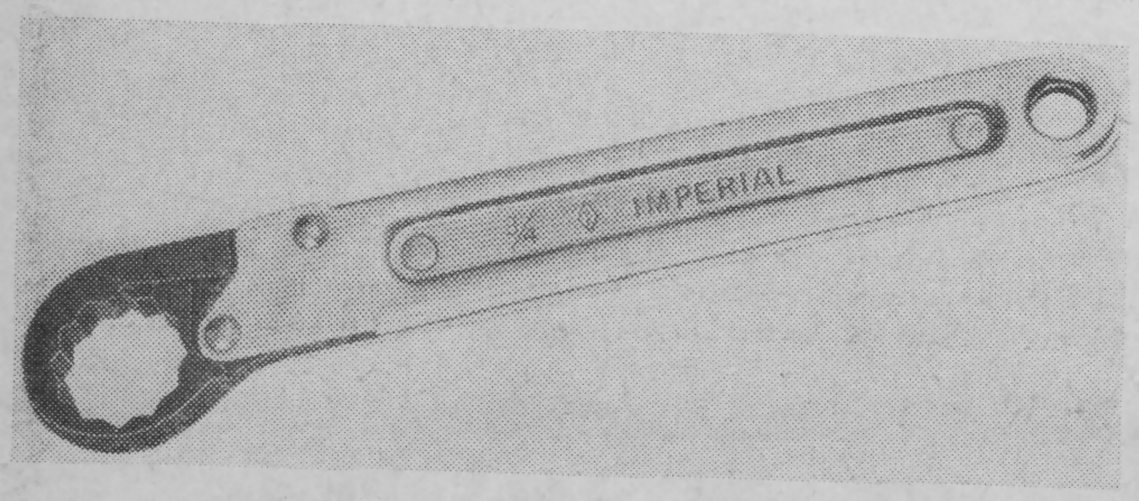


← **Ring Enables the User to Finger-hold Nuts or Bolts** in snug working areas. Will not restrict hand or finger motion. Wrenches are adjustable to fit differently sized fingers and are supplied in $1.98 sets of four by Beaver Tool Co., P. O. Box 256-mm, Huntington Station, New York.





← ↑ **Movable Head on Ratchet Wrench** speeds attaching and removal. Once the wrench is in working position, the harder the pull, the tighter the jaws close. Wrench needs only 30° handle movement to get a new grip on nut. Called the **Quik-Tite,** the wrench is available for the following hex nut sizes: 3/8, 7/16, 1/2, 9/16, 5/8, 11/16, 3/4, 13/16 and 7/8 in. Prices range from $3.50 to $5.30, according to size. Made by The Imperial Brass Mfg. Co., 6300-SM W. Howard St., Chicago 48, Ill.

1

Out of the water, this 17 trailer. The retractable hydraulically and fold in bottom surface when th Amphibious

THIS is the year y
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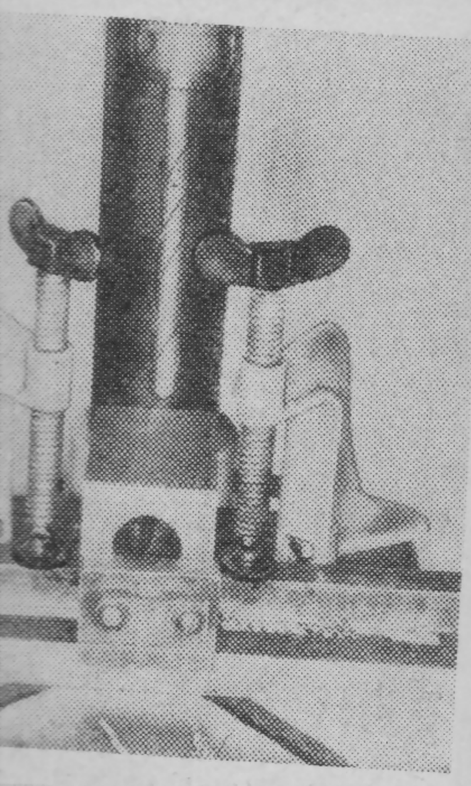
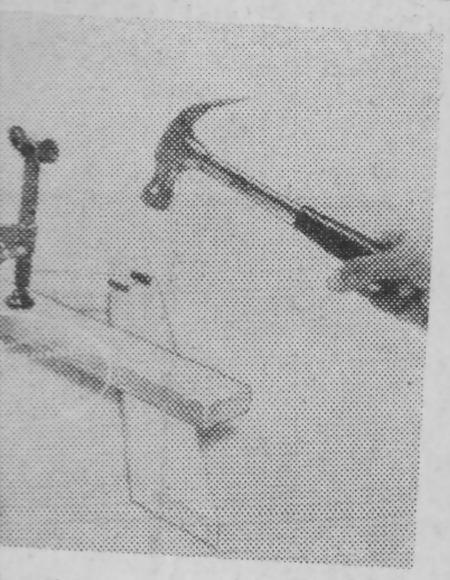




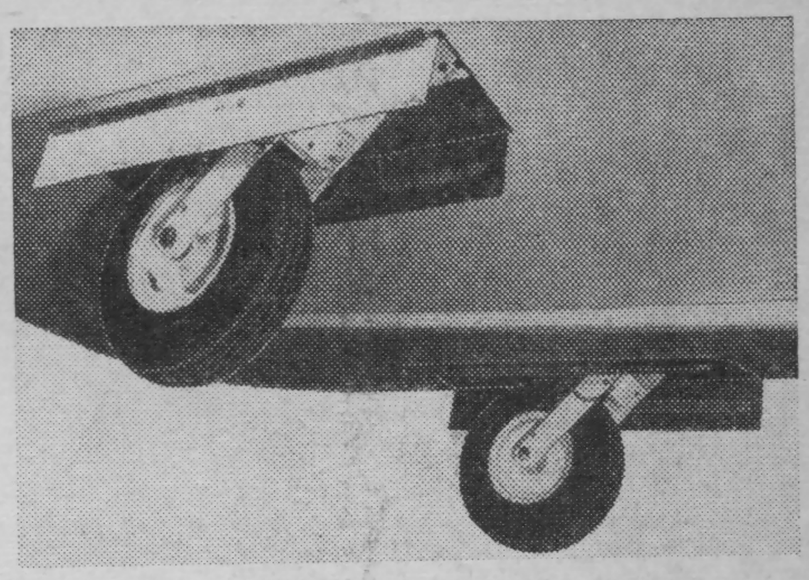
Head on Ratchet Wrench and removal. Once the king position, the harder er the jaws close. Wrench andle movement to get a Called the **Quik-Tite**, the le for the following hex , ½, 9/16, ⅝, 11/16, ¾, Prices range from $3.50 g to size. Made by The fg. Co., 6300-SM W. go 48, Ill.

What's New in Boating?

—the 1960 formula is amphibs and more power

1

Out of the water, this 17-ft. fiber glass runabout is its own trailer. The retractable wheels (see inset photo) operate hydraulically and fold into the hull to give a level-plane bottom surface when the *Amphibian* is in action. $1795. Amphibious Boats, Inc., Dallas, Tex.



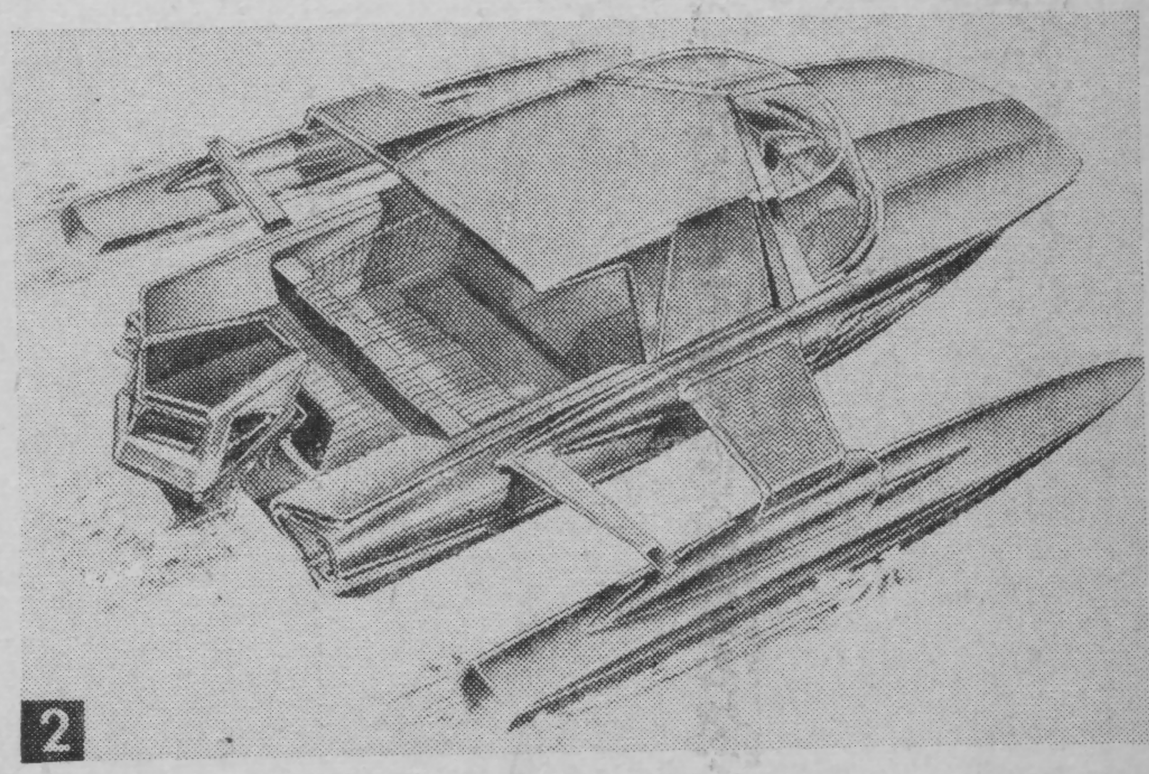
THIS is the year you can look out the window and see more and more boats cruising down the street—without the customary trailers.

It is also the year when manufacturers have renewed their horsepower race, with the power of outboards surging to a record 80 *hp*.

Boat builders have taken a tip from the airplane industry and are putting retractable "landing gear" into their boats, making them, in effect, their own trailers.

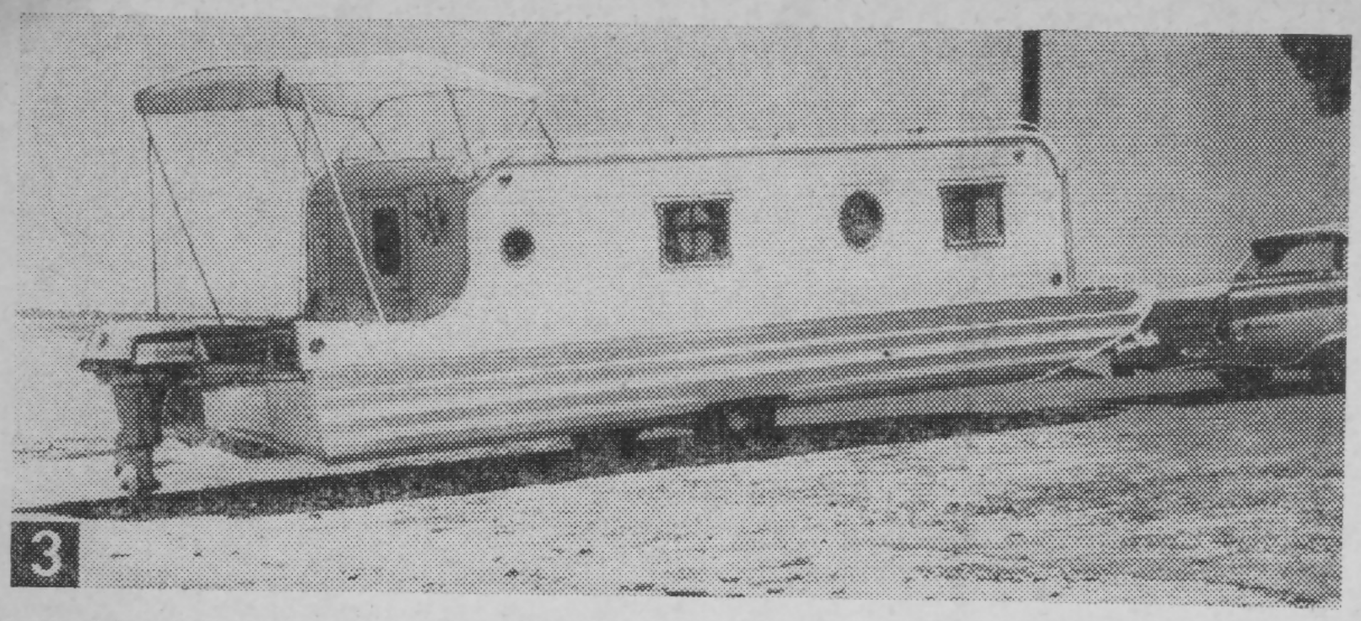
And it is not only the smaller runabouts that are sprouting wheels. Full-size cabin cruisers and houseboats also are taking to the highways amphibiously.

Why the "Amphibs"? The development probably is one that



2

Evinrude's 1960 "dream" boat is the *Jetstream*, a 16-ft. runabout with retractable pontoons. Designed by Brooks Stevens, the craft attains planing speed on its main hull. Then the pontoons are lowered to bear the weight of the boat, lifting the hull clear of the water.



Just back this 32-ft. *Terra-Marina* houseboat down to the water's edge on its built-in trailer, and you're in business. Its insulated cabin sleeps nine and has full galley facilities as well as a divider curtain to partition it off into two rooms. $3695. Terra-Marina Mfg. Co., Inc., Houston, Tex.

This intriguing, experimental catamaran is of aircraft-type construction: welded tubular frame, covered with aluminum. Fourteen feet long and 8 ft. wide, it has upholstered bucket seats and has reached 40 *mph* with a 35-*hp* motor. The Mitchell Boat Co., Elkhart, Ind., developed it.

had to come about. The amazing upsurge in family boating that has boosted the entire industry into a 2½-billion - dollars - a - year business has resulted from several factors—one of them being the easy transport of boats overland by trailers.

The next step, logically, has been to give the boats their own wheels, built right in for greater convenience.

Amphibian manufacturers say they have numerous advantages over the conventional trailers. No danger of warped planing surfaces from improper loading on a trailer. No time-consuming tie-downs when loading. And—at least in the case of runabouts—most amphibs trail lower than those carried on separate trailers, giving the driver of the car better vision to the rear.

The *Amphibian,* made by Amphibious Boats, Inc., Dallas, Tex., is a good example (see Fig. 1). Wheel hatches on the boat open and close automatically as the wheels are lowered or raised. The closed hatches fit tightly into and level with the bottom, giving a smooth, friction-free surface.

The wheel assembly itself retracts into enclosed wheel wells within the hull. These wells form the foundation for rubber-padded seats.

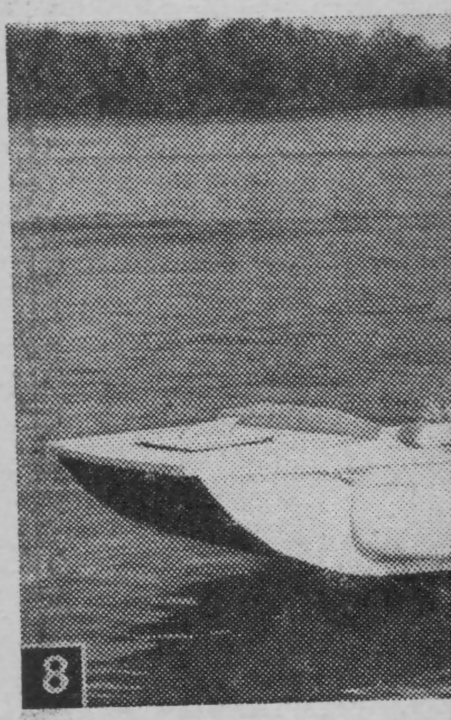
Aimed at the Family, too, is an ever-increasing number of boats intended to get mom, dad and the kids all out on the water together.

Red Cross Mfg. Corp., Bluffton, Ind., has come up with an e pontoon craft for 1960. called *Parti-Barge,* ha construction, with ma decks. Additional secti deck and railings can b of the company's four creasing by 4-ft. lengths

Coons Custom Coac wego, Kans., has approa convenience from a di than built-in wheels. makes the *Dreamer* which mounts on picku 1960 it has added a po accessory. The float, c board motor combine plete houseboat, with g sleeping accommodatio

Curd Craft, Addison of catamarans with ret called *Float 'n' Tote.* ft. up to 24 ft. and the forced steel chassis w

Here are a collapsible and two convertibles. The *Waverider* (A) is a 16-ft.-long British sloop-rigged catamaran that can be dismantled and folded into a carrying case 16 by 2 by 3 ft. Price with sails: $1750. American distributor is Waverider Corp., New York, N. Y. The 15-ft. fiber glass *Bockster* (B) becomes an outboard runabout with a flip of the demountable aluminum mast. Less the motor, it sells for $995. Bock Boats, Inc., Toledo, Ohio. The *Playmate* (C) converts easily to a dinghy or an outboard. Its 9 ft., 5 in. hull is of reinforced fiber glass. Price, including cotton sail, is $499. Tri-Star Division, Detroit, Mich.



This *Satti-Skiff* has a s weighs 96 lbs. and is 7-f hatch lifts out to provid A 5½-*hp* motor will plan although three can sit Plasti-Kraft Co

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Aimed at the Family, too, is an ever-increasing number of boats intended to get mom, dad and the kids all out on the water together.

Red Cross Mfg. Corp., Bluffton, Ind., has come up with an enlarged line of pontoon craft for 1960. The new line, called *Parti-Barge,* has two-pontoon construction, with marine plywood decks. Additional sections of pontoon, deck and railings can be added to three of the company's four new models, increasing by 4-ft. lengths.

Coons Custom Coach Mfg. Co., Oswego, Kans., has approached amphibian convenience from a different direction than built-in wheels. The company makes the *Dreamer* camping body, which mounts on pickup trucks, and for 1960 it has added a pontoon float as an accessory. The float, coach and an outboard motor combine to form a complete houseboat, with galley, dining and sleeping accommodations.

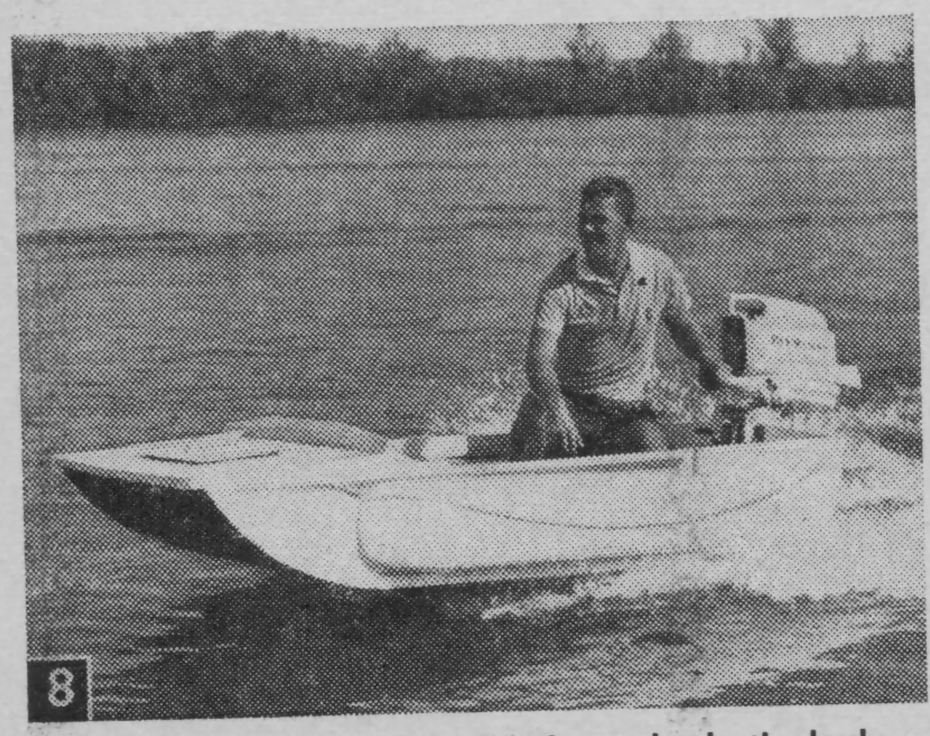
Curd Craft, Addison, Ill., is selling a line of catamarans with retractable trailer wheels called *Float 'n' Tote.* Lengths range from 14 ft. up to 24 ft. and the boats feature a reinforced steel chassis with a fiber glass hull.

In the water is the fiber glass top half of the *Nomad.* On shore, covered with a weatherproof shelter, is the trailer bottom-half. The two fit together for trailing, weigh 350 lbs. in all. Price of the boat-trailer-shelter combination: $647. Knight Mfg., Inc., Atlanta, Ga.

In Germany, where this inflatable boat is made, it's called the *Schlauchboot*—or "tube-boat." Made of rubberized fabric, it's 12 ft. long and when deflated, rolls up into a sea bag. $549. American distributor is American Auto Boat, Milwaukee, Wis.

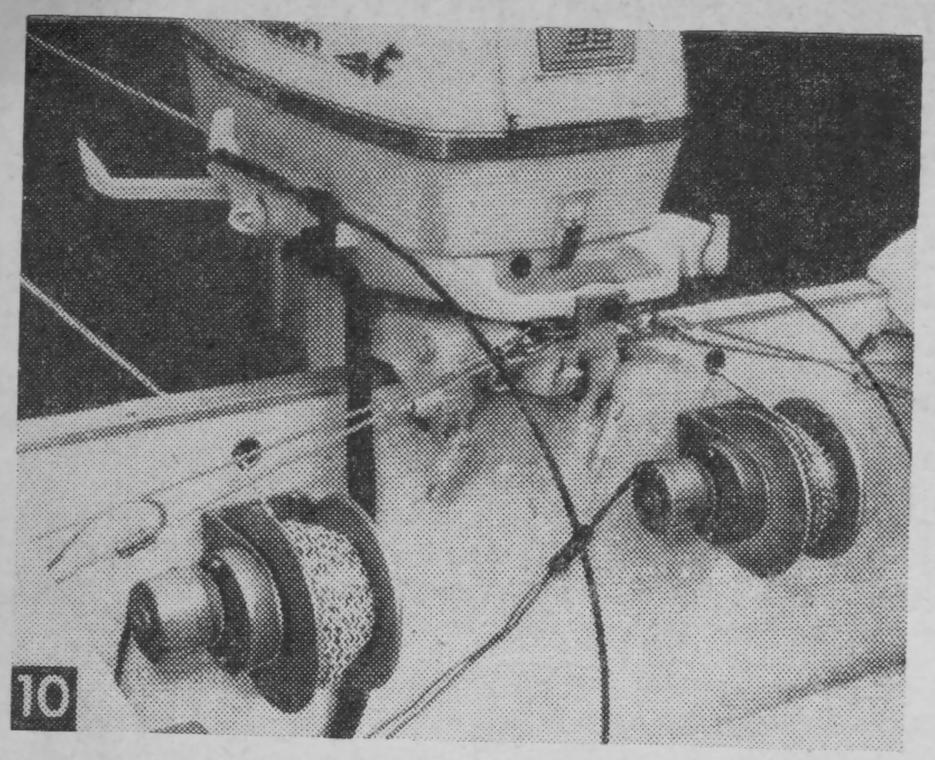
Optional fittings include fiber glass or canvas cruiser tops; stainless steel chairs, bunks and head accessories, and an aluminum mast and boom to convert the craft into a sailboat.

For those who like their family boats big



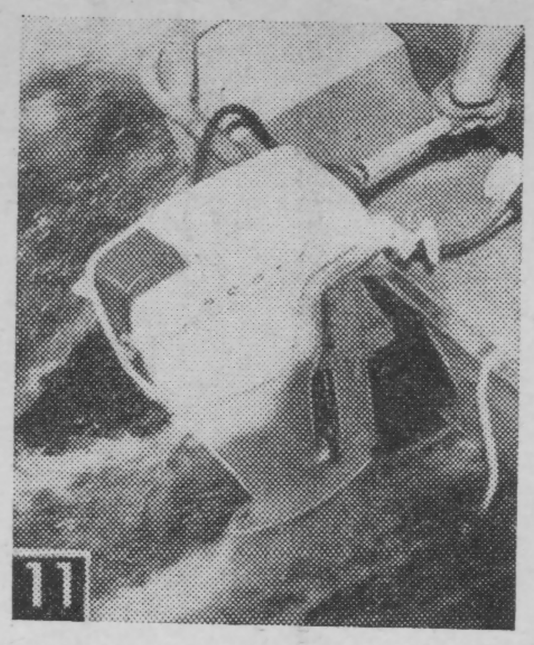
This *Safti-Skiff* has a solid foamed plastic body, weighs 96 lbs. and is 7-ft., 11-in. long. Its forward hatch lifts out to provide additional storage space. A 5½-*hp* motor will plane it with one person riding, although three can sit comfortably. $219. The Plasti-Kraft Corp., Oldsmar, Fla.

Handy for use as a tender or a car-top fishing boat, this 8-ft. pram has a clear butyrate plastic hull. Fitted with mahogany seats and gunwale, it weighs only 44 lbs., can be fitted with a 3-*hp* motor. $199.95. Sudbury Laboratory, Sudbury, Mass.



10

Operated from either a 6 or 12-volt motor, this *Ski-Reel* ends the troublesome job of handling water ski tow ropes. A regular automobile battery supplies the power. Push button operation is provided by a switch that can be mounted by the steering gear or on the gunwale. Price, less battery and rope, is $44.90. K-D Engineering, Lincoln, Nebr.



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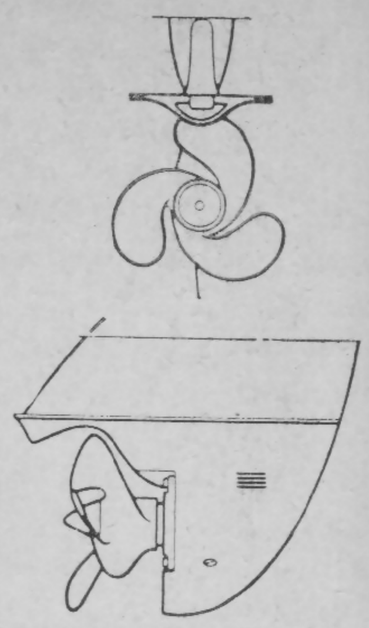


Scott's trim little 7½-*hp* fisherman's motor weighs in just under 40 lbs. For storage, the steering and throttle control handle swings down flat instead of up and above the motor housing as on most motors. Drawings show how lower unit of Scott's new 7½-*hp* model was designed to make the motor weedless. Note the three back-swept blades that keep weeds from getting to the prop shaft and the contoured housing against which weeds are cut by propeller action.

and luxurious, Chris-Craft Corp., Pompano Beach, Fla., is offering a new 55-ft. *Constellation* motor yacht. It has Philippine mahogany construction, double-planked bottom and batten-seamed hull sides and twin engine options up to 672 diesel horsepower.

Biggest news from Grumman Boats, Inc., Marathon, N.Y., is the company's first plastic boat.

Long a big name in the aluminum boat field, Grumman is now using glass mat, glass cloth and woven rovings combined with a polyester resin for its *GC* 17-ft. runabout. It has a one-piece hull with a modified-V bottom, a one-piece deck attached at the gunwale line and a plastic fender rail fastened all around the outwale.

New this year from Dorsett Plastics Corp.,

196?'s Outboard Motor?

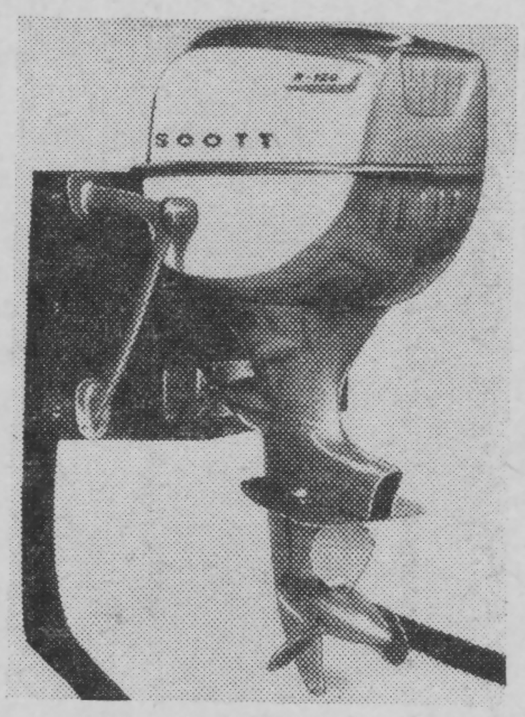
With the outboard motor makers started on another horsepower race, the motor shown here could be a forerunner of things to come.

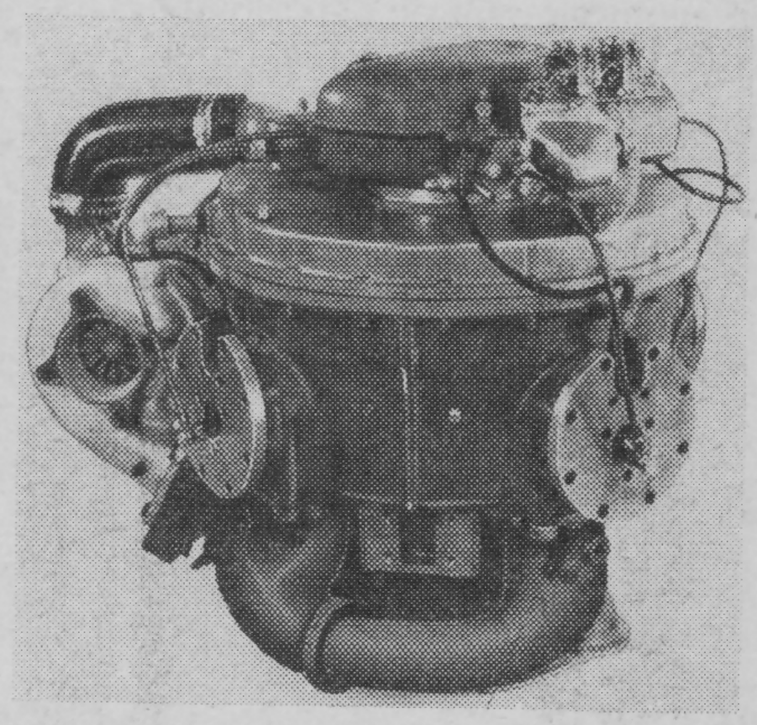
Called the *Scott R-120,* it pulls 110 *hp* at 4200 *rpm* and Scott rates it as high as 125 *hp.* Displacement is only 90 cu. in. Not bad, when you consider how hard the outboard engineers have been trying to achieve more than 1 *hp* for each cubic inch of displacement (Mercury does it on three 1960 models, but just barely).

The R-120's 260-lb. weight compares favorably with that of Mercury's less powerful 80-*hp* model, which hits the scale at 195 and is the nearest thing to it in power.

A well-balanced 4-cylinder radial power-head, turbo-supercharged and with direct cylinder fuel injection gives the R-120 its punch. And instead of using oil mixed with gasoline, the engine has an oil-lubricated crankcase.

McCulloch Corp., Minneapolis, Minn., which makes the Scott line, says the R-120 is purely "experimental" and "not intended for production as an entire assembly." Possibly significant, though, is the fact that Scott did not boost its 1960 on-the-market power over last year's 60-*hp* model. Could be they're holding the R-120 in reserve for a year or so.





At left, Scott's R-120 experimental radial outboard motor. For steering, only the lower portion of the motor—the part in the water—turns. Adjustable tilt or trim is permissible while the motor is in use. At right, view of R-120's powerhead shows two cylinder heads. Unitized fuel injection and ignition system are on top of motor, with turbo-supercharger at left. Specific fuel consumption is reported as .055 lb./*hp*/hr.

His foot on the *Ful-Control* th
his hands free for trolling.
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How Big Can a M

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As long as the boat
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Evinrude's 75-*hp Starflite II*
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Photo 13A shows front view
in normal position. Photo
view from rear, with brack
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son's new 75-*hp* motor also
shocks.

Stencil Boat Numbers

New laws in many states requiring 3-in. registration numbers on power boats will mean more expense and work fitting out for the new season.

You can simplify the task by using 3-in. letter stencils, available at most stationery

Clean the side of your boa
mask off the areas around the
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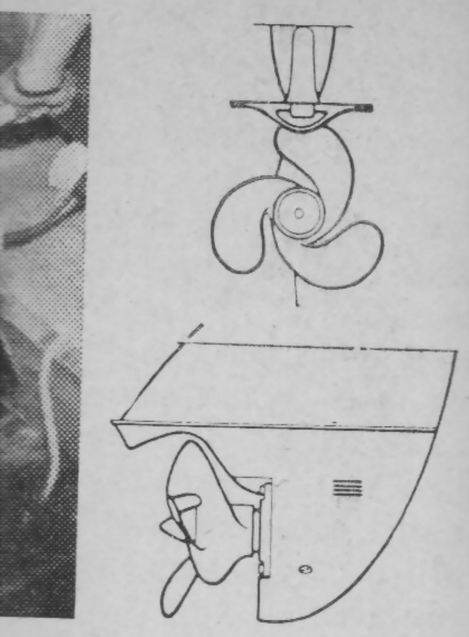
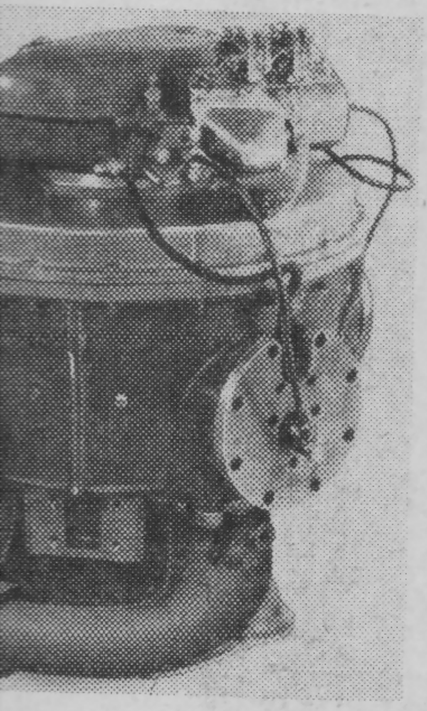


sherman's motor weighs in storage, the steering and vings down flat instead of housing as on most motors. r unit of Scott's new 7½-*hp* make the motor weedless. t blades that keep weeds shaft and the contoured eeds are cut by propeller on.

n the aluminum boat using glass mat, glass ngs combined with a *GC* 17-ft. runabout. ll with a modified-V k attached at the gun- fender rail fastened .
Dorsett Plastics Corp.,



or. For steering, only the turns. Adjustable tilt or ew of R-120's powerhead nition system are on top consumption is reported

as an entire assembly." the fact that Scott did et power over last year's holding the R-120 in re-

His foot on the *Ful-Control* throttle, this fisherman has his hands free for trolling. Adjustable to any hull contour, the treadle is designed to pivot: press the toe to accelerate, depress the heel to slow down. $39.50. Tempo Products Co., Cleveland, Ohio.

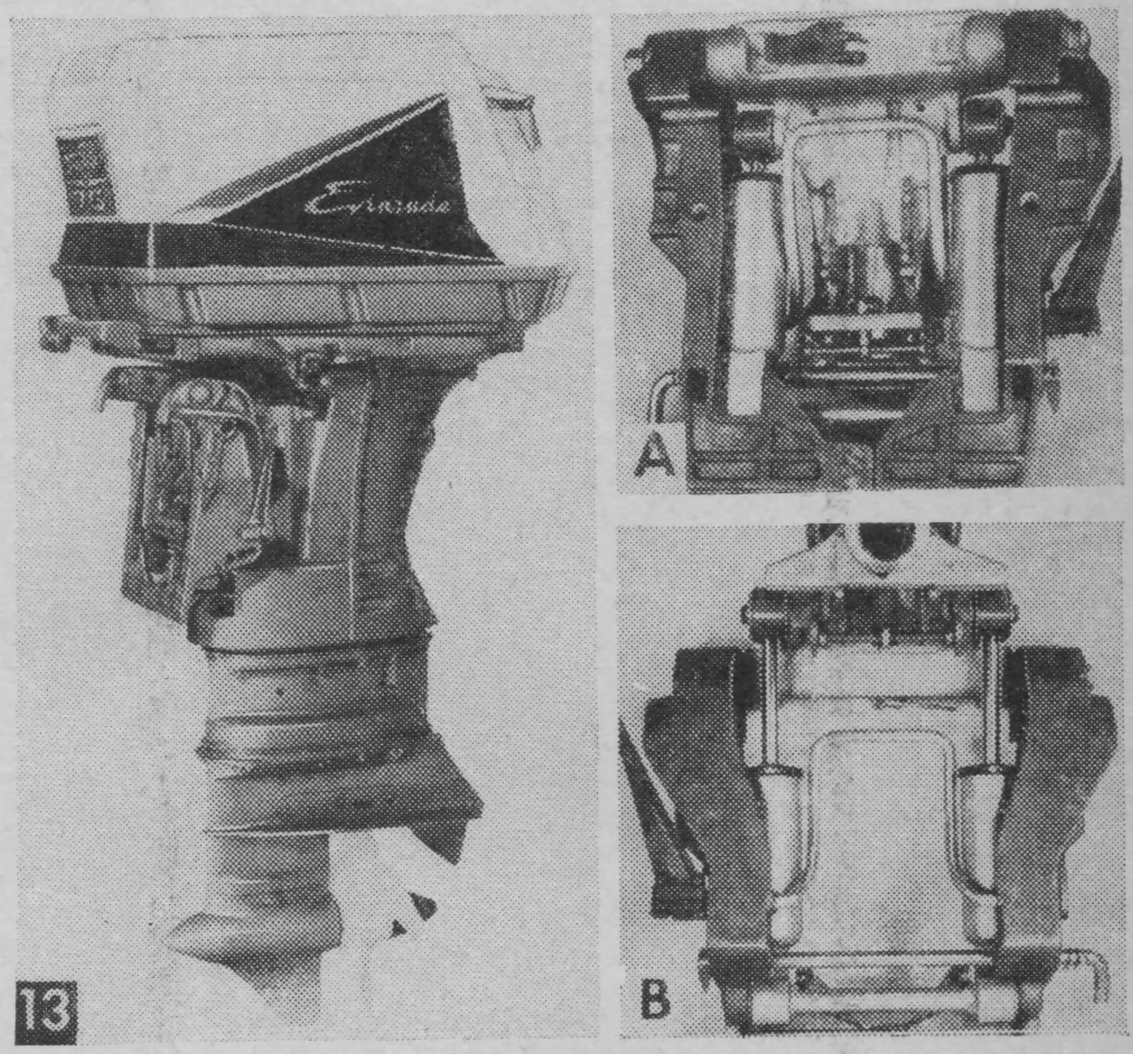
Santa Clara, Calif., is a *Tilt-Lock* windshield on its runabouts. The windshield locks firmly in place when the boat is running, but it can be folded back and down to make it easier for you to get in and out when beached or moored.

A 1960 innovation by the Performer Boat Corp., Bellflower, Calif., is a complete galley built in under flip-back seats, optional in the company's 18-ft. *Seven-Seas* cruiser. By flipping back the helmsman seats, you have twin serving tables, with a stove and ice box on one side and a sink and food storage compartment on the other.

How Big Can a Motor Get? Power is going in the same direction it has been heading for the past few years—*up*. A natural question to ask, now that Mercury has reached 80 *hp* and Johnson and Evinrude both are at 75, is: "Are there any limits in sight?

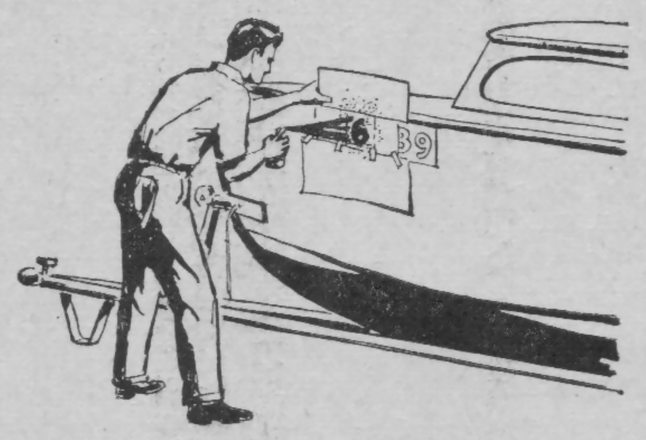
The answer from several of the motor makers themselves is that whatever limits there may be are imposed not by motor design, but by boat design.

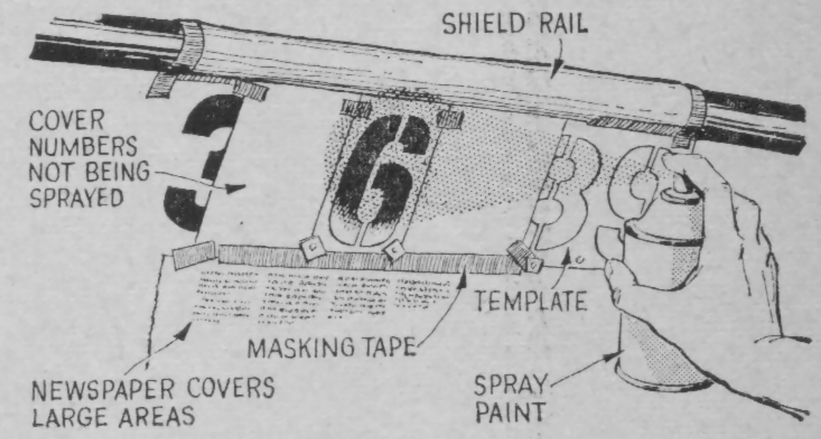
As long as the boat manufacturers keep moving ahead, keep



Evinrude's 75-*hp* *Starflite II* features two double-action hydraulic shock absorbers built into its stern and swivel brackets. Photo 13A shows front view of bracket in normal position. Photo 13B shows view from rear, with bracket tilted up to limits of the shock absorbers. Johnson's new 75-*hp* motor also has the new shocks.

Stencil Boat Numbers



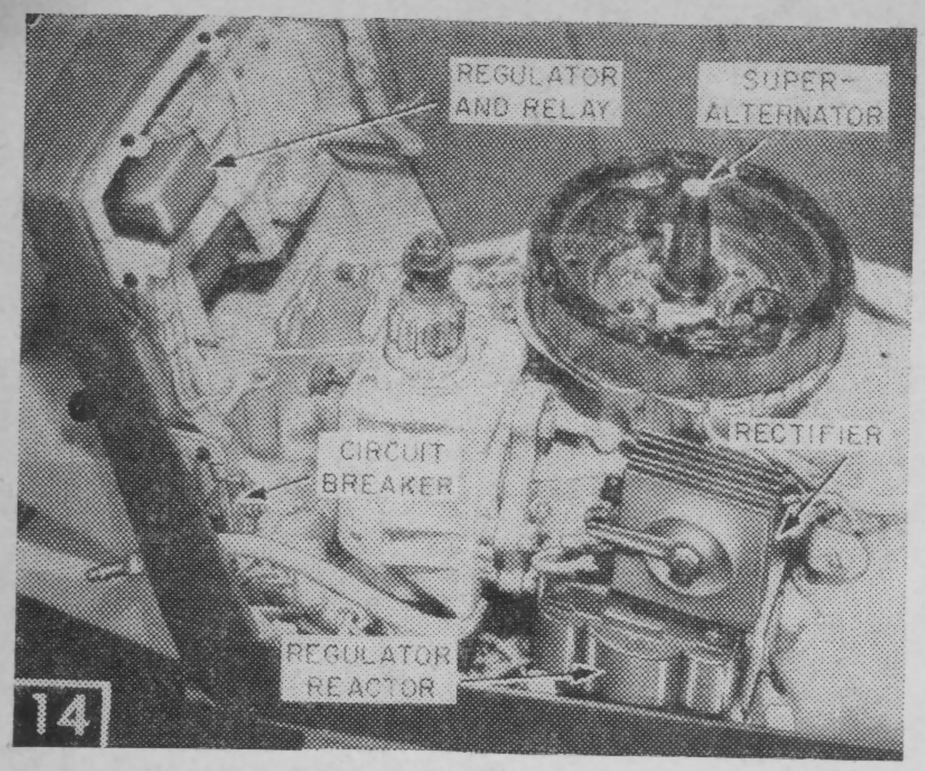


New laws in many states requiring 3-in. registration numbers on power boats will mean more expense and work fitting out for the new season.

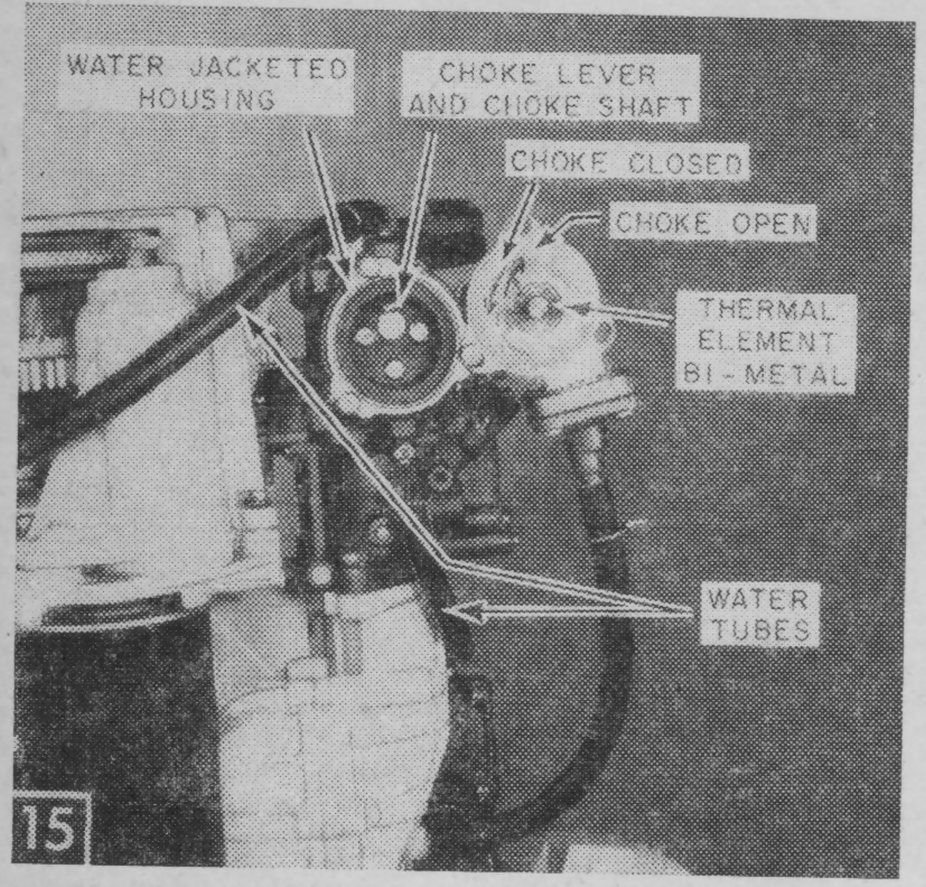
You can simplify the task by using 3-in. letter stencils, available at most stationery stores.

Clean the side of your boat thoroughly, then carefully mask off the areas around the stencil as well as the openings in the stencil not being used. Use quick-drying spray paint to spray one letter or number at a time. If your number is short, you may be able to cut the stencils apart and tape them together for your sequence.

As an alternative, to avoid the inconvenience of masking, you can try using a brush. Select one with short bristles and use it to stipple on the numerals through each of the stencils, one at a time.—DAVID M. SWARTWOUT.



Standard equipment on West Bend's new 40-*hp* electric-starting *Golden Shark* is this super-alternator generator with 25-ampere capacity—five more amps than last year. Automotive-type regulator and relay protect battery from overcharge. Circuit breaker safeguards entire electrical system.



The first automatic choke to be used by the outboard industry, this one is on some Johnson and Evinrude motors this year. Heat radiated by its water-jacketed housing is absorbed by the thermal element, which expands or contracts, depending on water temperature. This opens or closes choke, which can also be operated manually.

coming out with boats that can handle more and more power, the motor makers still have a good ways to go in the direction of more horsepower.

In brief, it appears that it is up to the boat builders to keep pace with the motor manufacturers.

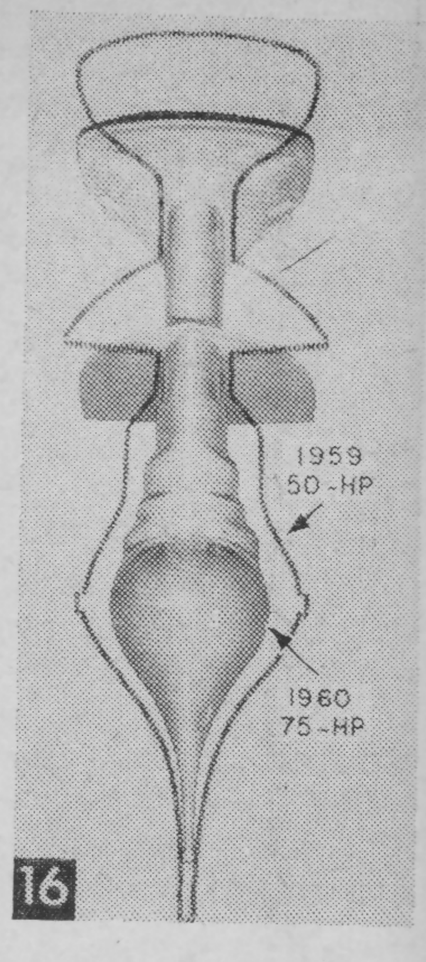
The pace is a swift one, judging from what is happening this year. As mentioned Mercury has a new 80-*hp* motor—the *800*—to replace last year's 70-*hp* model. The Johnson and Evinrude 75s take the place of 1959's

Johnson and Evinrude, which usually go hand-in-hand in their improvements, have newly-designed gear cases on their big 75-*hp* motors. Note from this front view of the lower unit how it is slimmer than that of last year's 50-*hp* model, to reduce water resistance.

50-*hp* motors, a considerable increase in power.

Gale has jumped on the bandwagon, too, adding the 60-*hp V-Sovereign* to its line, which last year was headed by a 35-*hp* model.

And while Scott is standing pat in the power race, going with the same 60 *hp* they offered last year, we suspect they may be keeping an ace up their sleeve for next year or the year after (see P. 120).



Scott's hole-card for this year is its completely re-styled and re-designed 7½ *hp* fishing motor—one of the smallest and lightest ever offered in or near this power class (see Fig. 11). It weighs in at just under 40 lbs., fully 25 lbs. less than the 1959 model of the same power. It is about 30 in. long, some 7 in. shorter than last year.

The tremendous size and weight reductions were made possible primarily by mounting the engine block directly on the lower unit housing, eliminating the adapter used below the powerhead on older models. Other factors are a shorter drive shaft and shaft housing, cast aluminum connecting rods instead of steel and a light-weight plastic hood cover.

More technically-minded boatmen who have been waiting for a manufacturer to come out with a tachometer on the motor should welcome the tach included as standard equipment with the 60-*hp Flying Scott* and the 40-*hp Royal Scott*. Mounted on the dash, it registers motor *rpm* at all throttle settings. All Scott's electric-starting models now have an a-c generator—lighter and smaller than the d-c generators they replace, but with double the output (18 to 20 amps).

Gale's New 60-*hp* Motor comes with a streamlined underwater unit, designed to minimize drag and turbulence (see Fig. 17). Key to its effectiveness is a new gear ratio, which increases propeller speed to 85% of motor speed. The company also has dropped last year's 12-*hp* model and replaced it with a 15.

West Bend hasn't boosted power any. Its 40-*hp Golden Shark* still tops the line. It has dropped three motors—the 35-*hp*, the 16 and

the 6—but added an 18 a
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Besides their new 75-*hp*
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Double-action shock a
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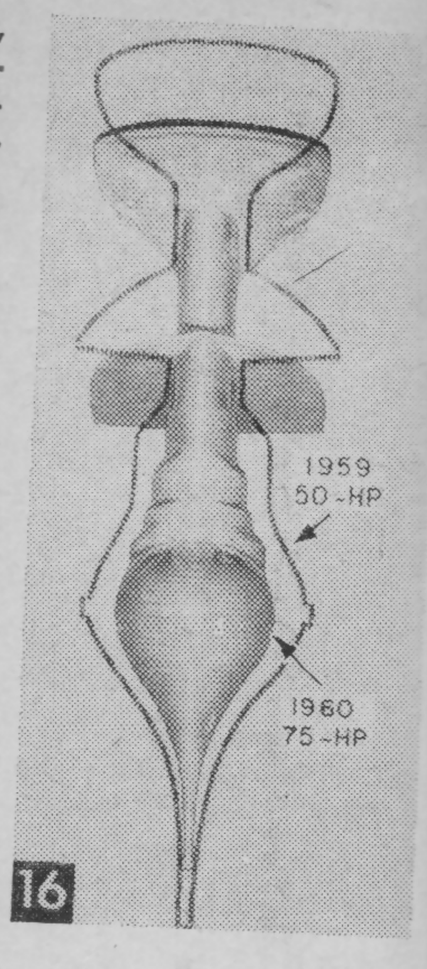
WAYNE WILLE.



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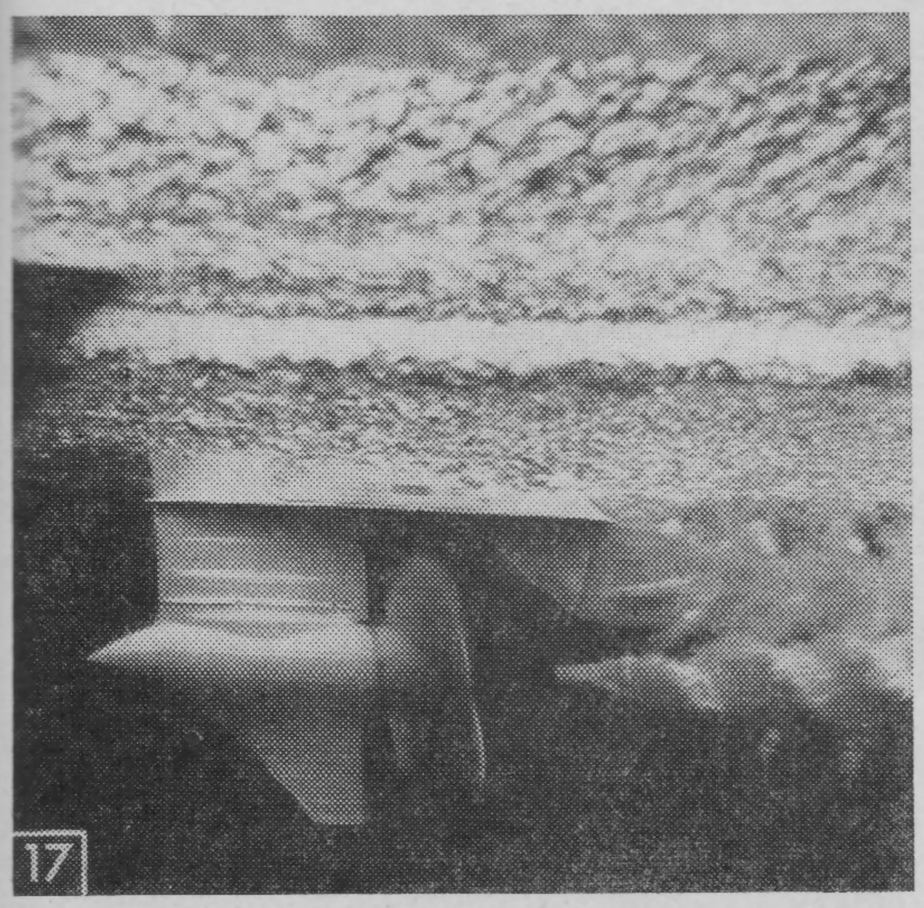
de, -in- ve- de- eir ote the im- ast re- . d- in on o, y- e, s p s e th the same 60 *hp* they suspect they may be eir sleeve for next year e P. 120). r this year is its com- e-designed 7½ *hp* fish- e smallest and lightest r this power class (see at just under 40 lbs., the 1959 model of the ut 30 in. long, some 7 ear. and weight reductions rimarily by mounting tly on the lower unit e adapter used below models. Other factors aft and shaft housing, ting rods instead of t plastic hood cover. nded boatmen who a manufacturer to meter on the motor h included as stand- e 60-*hp Flying Scott* ott. Mounted on the *rpm* at all throttle ctric-starting models nerator—lighter and erators they replace, put (18 to 20 amps). otor comes with a unit, designed to ulence (see Fig. 17). is a new gear ratio, er speed to 85% of ny also has dropped nd replaced it with sted power any. Its tops the line. It has e 35-*hp*, the 16 and

the 6—but added an 18 and a 25. Also new is its super alternator generator, with capacity increased to 25 amperes from last year's 20. It is standard equipment on the Golden Shark (see Fig. 14).

Besides their new 75-*hp* models, both Johnson and Evinrude also have come out with new 40-*hp* motors in place of the 35s offered last year. An automatic choke—the first in the industry—is standard on both manufacturers' 75s and in their electric-starting 40s (see Fig. 15).

Both also offer a selection of three propellers with the 75s to meet the requirements of a wide range of outboard boats and uses. The motors are shipped with a 10 by 11 prop, good



17

This underwater photo shows how Gale's new missile-shaped lower unit minimizes turbulence and drag. Here the 60-*hp V-Sovereign* is going 35 *mph*, and the only turbulence evident is at the rear of the lower unit, just below the exhaust.

for average use, including water skiing. Also available are a higher speed 10 by 12 prop for lighter and faster boats and a 10¼ by 10 for larger, heavier craft.

Double-action shock absorbers (see Fig. 13) are built into both 75s to safeguard against damage which might result from the lower unit striking underwater objects at high speeds. The shocks cushion the initial force of hitting the object, then set up a reactionary force which reduces impact against the boat's transom when the motor returns to normal position.

Interestingly, from a design standpoint, these motors are half again as powerful as last year's 50-*hp* models—yet their weight has not increased accordingly. Both 75s weigh 216 lbs., while Evinrude's electric-starting 50 weighed 221 lbs. and Johnson's 215.—WAYNE WILLE.

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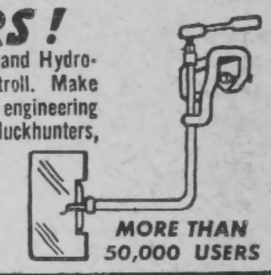

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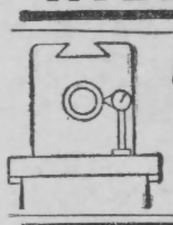

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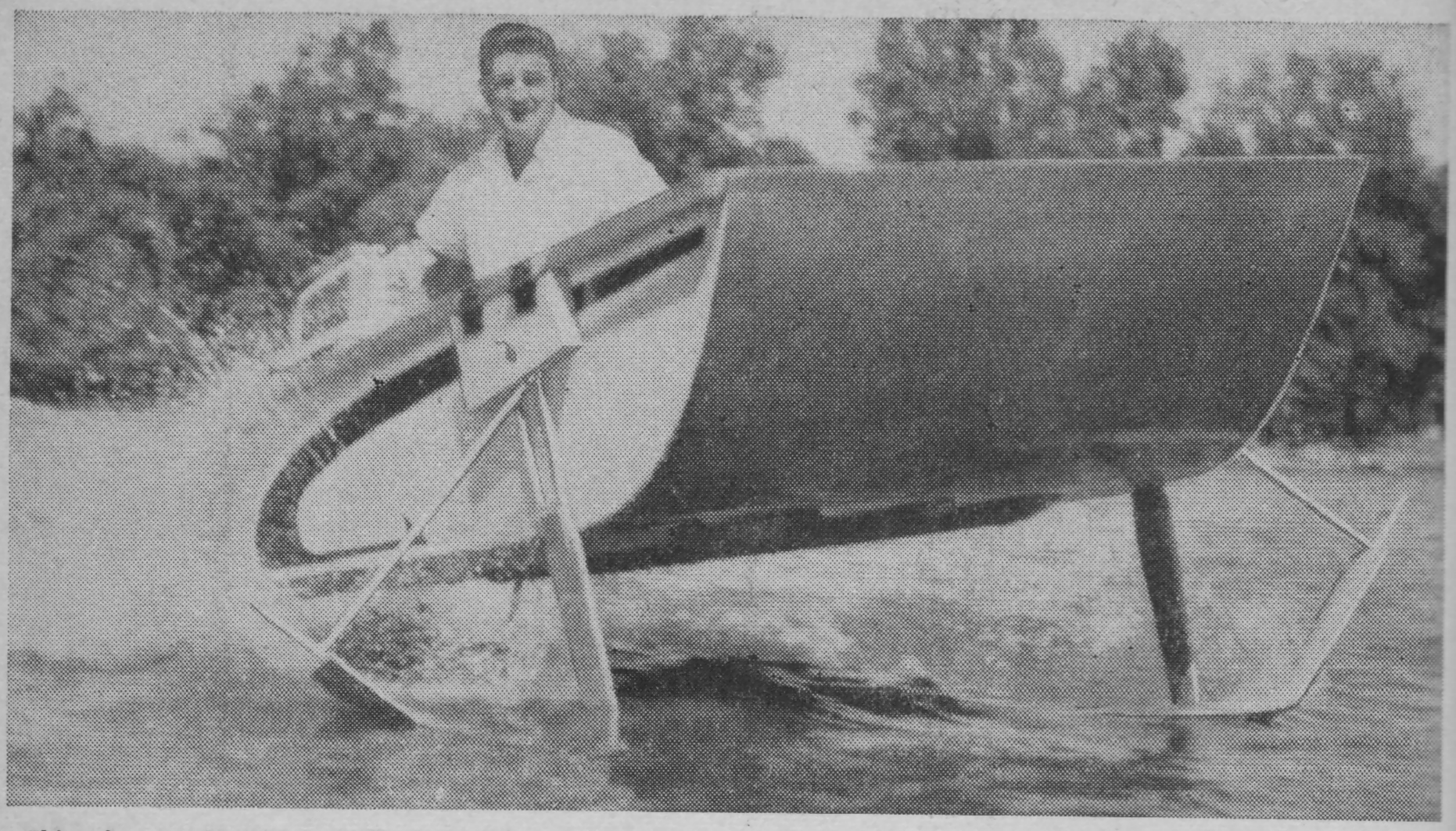


This photo, taken just as the boat came out of a turn, indicates a slight heeling over toward the inside of the turn. This may be due to natural tendency of driver to lean toward inside of turn.

HOME-BUILT HYDROFOIL BOAT

Part 2. Building a hi-lift hull especially designed for use with hydrofoils

By WILLIAM D. JACKSON

Craft Print Project No. 304

AFTER completing the fore and aft hydrofoils as described in Part 1 (S&M February '60) your next step is the construction of the boat on which the foils will be used.

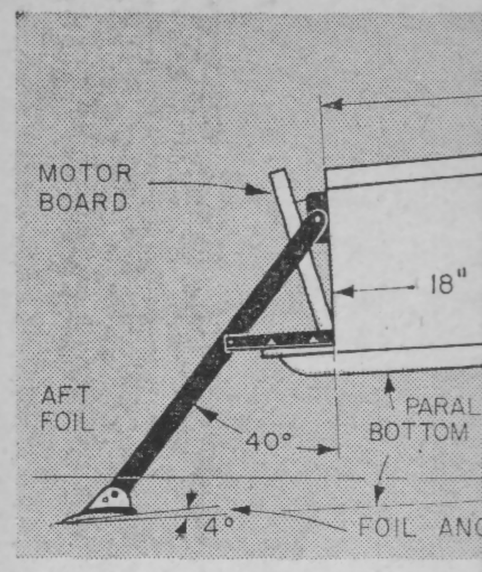
We selected a hull design having a scow-shaped bow with battened air traps on the underside because these high-lift characteristics aid the foils in lifting the hull clear of the water more readily than a conventionally shaped boat.

Building the Hull. Start by laying out the two hull side pieces on a 10-ft. long panel of ¼-in. plywood to the dimensions given in Fig. 6. Note that the sides taper from 18 in. at the bow to 14 in. at the stern. The additional ½ in. shown at the top of the hull side represents the sheer rail (Sec. D-D in Fig. 8) to be attached later. Be sure to lay out and cut the ⅜-in. notch on the bottom edges of the sides. Do not, however, cut notches in the hull sides for the 2 x 4-in. stock used to back up the seam in the bottom planking.

With the sides cut to shape, use them as patterns to mark the curves and notches for cutting the chines from 2 x 4-in. stock. Cut the 1⅝ x 3⅝-in. notches in the fore ends of the chines before fastening them to the hull sides. Rip saw the sheer moldings from 2 x 4-in. stock and cut a ¼ x 1⅛-in. rabbet along one side of each molding for the hull sides as in Sec. D-D in Fig. 8. Again using the curved bow of the hull sides as a pattern, lay out and cut a stem and filler block piece for each hull side. Also cut the two ¼-in. plywood gussets at this time.

Now, assemble chines, sheer moldings and stern pieces to the hull sides with waterproof glue and #8 x 1¼-in. *fh* screws spaced 4 in. apart. Use a double row of screws along the chines. When assembling the sides, be sure to make them up as a pair, one right and one left hand. Cut the aft side frames (Fig. 8E), foil retaining-bolt braces and upright (Fig. 8) and fasten to the hull sides. Rip the seat risers (Sec. A-A, Fig. 8) from a 2 x 4 and fasten to each hull side member with #12 x 2½-in. *fh* screws.

You are now ready to assemble the two sides to make up the hull. Since the bottom is covered with stock size plywood which is 4 ft. wide, cut the seat boards, stem cross piece, butt block and transom exactly 47½ in. long. First locate and fasten the seat boards to the seat risers with #8 x 1½-in. *fh* screws as in the top view Fig. 8. Then as-



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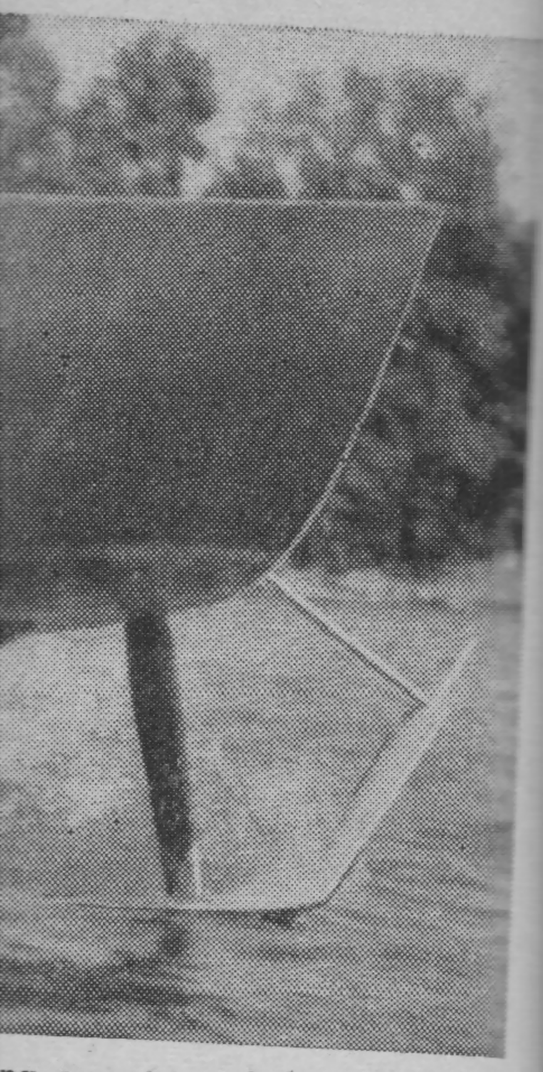

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BOAT

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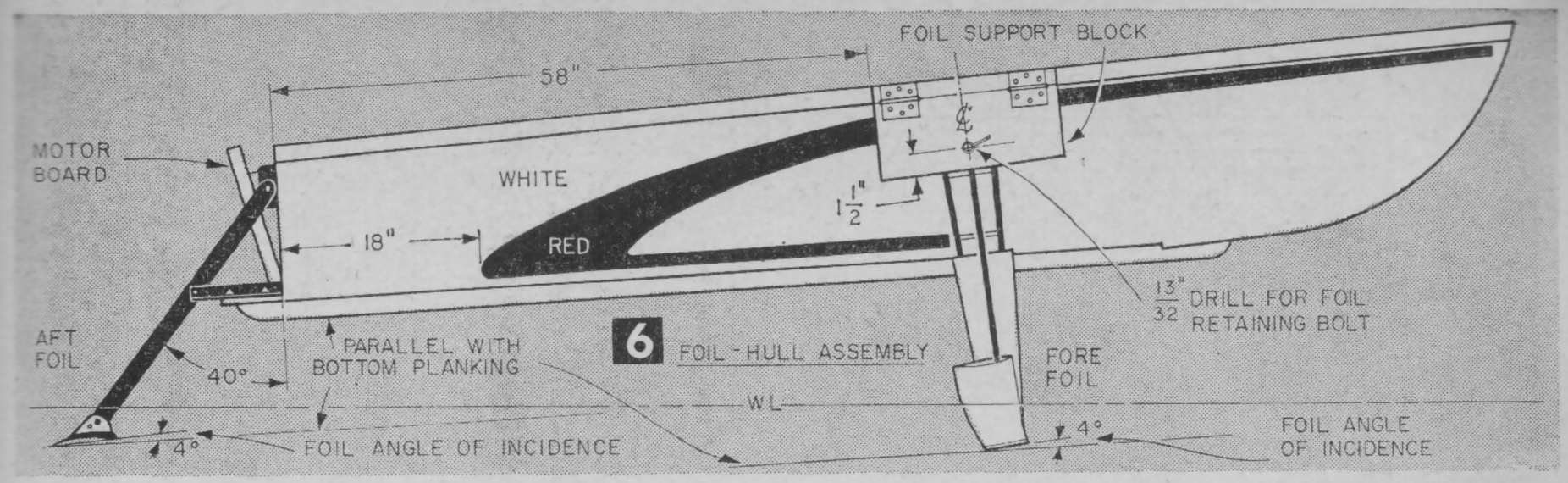


semble the ¾-in. plywood transom to the aft side frame members with Kuhls or Stay Tite neoprene sealer instead of glue, and fasten with #8 x 1½-in. *fh* screws spaced 2 in. apart. Fasten the stem cross piece to the stems with two #12 x 2½-in. *fh* screws at each joint. The other transom frame members shown in Fig. 7 can now be cut to size and fastened to the plywood transom with glue and #8 x 1½-in. *fh* screws.

Next, turn the hull framework upside down and block it up off the floor on a couple of 2 x 4's. Check the chines with a level lengthwise and across them with a straightedge and level to make certain the hull framework is not twisted. Use a wedge or small block to raise a low side or corner if need be. Then place the 2 x 4-in. bottom-planking butt block in the notches cut in the chines and fasten with two #12 x 2½-in. *fh* screws.

Before installing the bottom planking, fair the edges of the chines, butt block, transom and stems particularly where these members join one another so that the plywood planking will make good contact with them. Coat these contacting surfaces with neoprene sealer and place the 4 x 8-ft. panel of ⅜ in. plywood on the hull framework with the fore edge against the ⅜-in. notches cut in the chines and hull sides. The aft end of the plywood should project 6 in. beyond the transom. Fasten the plywood to the chines and transom frame with #8 x 1¼-in. *fh* screws spaced 2 in. apart. Space the screws about 6 in. apart when fastening the plywood to the butt block.

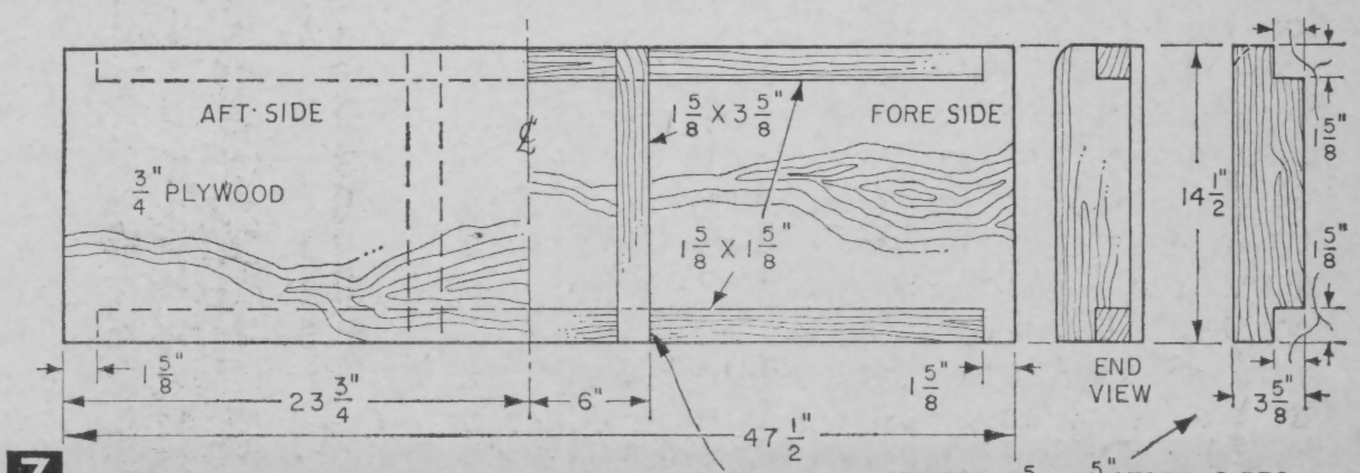
For the bow planking, use ⅜ in. plywood and install it with the grain running athwartship so it can be bent around the stems. Coat contacting surfaces with neoprene sealer and place the forepiece of plywood so that it overlaps the aft planking 5 in. Fasten fore plywood with #8 x 1½-in. *fh* screws driven into the butt block and spaced 4 in. apart. Then bend the plywood down and around the stems and clamp to the stem cross piece with C-clamps. Starting at the lapped joint and working toward the cross piece, fasten the plywood to the chines and stems with #8 x 1½-in. *fh* screws spaced 2 in. apart. Finally fasten the plywood to the cross piece.

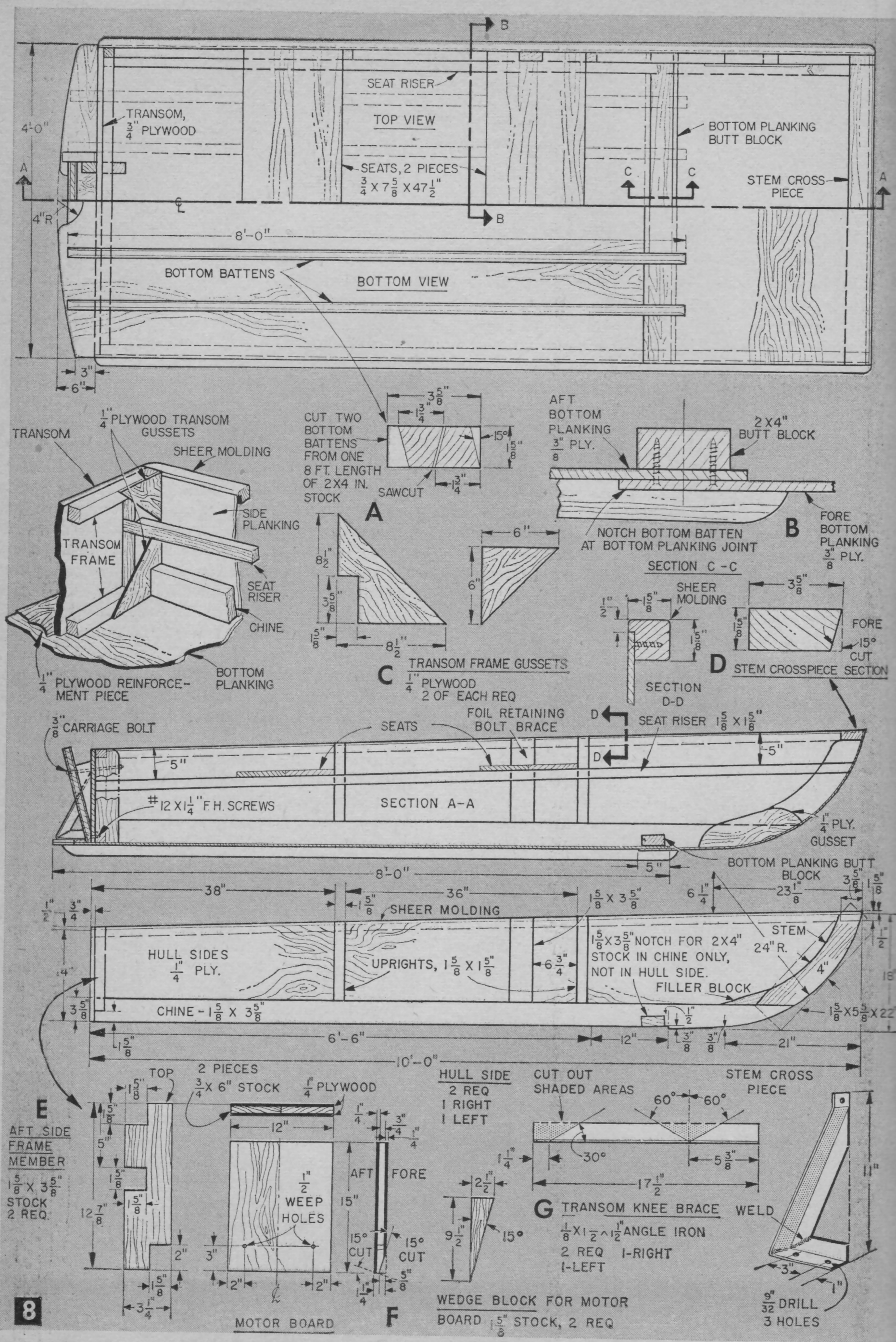
Going to the aft or transom end of the bottom planking that extends beyond the transom (Fig. 8), lay out the curved aft end by bending and clamping a ⅜ x ⅜-in. batten to the plywood. Use a compass to mark the 4-in. radius cutout for the outboard-motor shaft. Then cut to shape with a coping saw.

Cut a ¼-in. plywood reinforcement piece for the aft planking extension (Fig. 8) and fasten to the top side of the planking with neoprene sealer and 1-in. wire nails clinched on the top side.

With your circular saw set for a 15° bevel cut, rip the four bottom battens as in Fig. 8A. Round off the ends and place them on the bottom planking 1½ in. from the aft end and mark the battens for notching at the lapped joint of the bottom planking. To locate the batten position on the bottom, draw four lines on the bottom 8 and 16 in. from the chines on each side as in Fig. 9. Then drill a series of 5/32-in. screw pilot holes, spacing them 6 in. apart along the four lines.

When installing the battens, coat contacting surfaces with neoprene sealer and center them on the lines of drilled holes. First fasten each batten fore and aft with #12 x 2½-in. *fh* screws driven into the butt block and transom frame. Then, before the neoprene sealer has a chance to set, turn the hull over and continue to fasten the battens with #8





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15 in. high as in Fig. 8
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1¼ in. by laminating ¾
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and clamp until dry.
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Make two wedge block
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2¼-in. *fh* screws.

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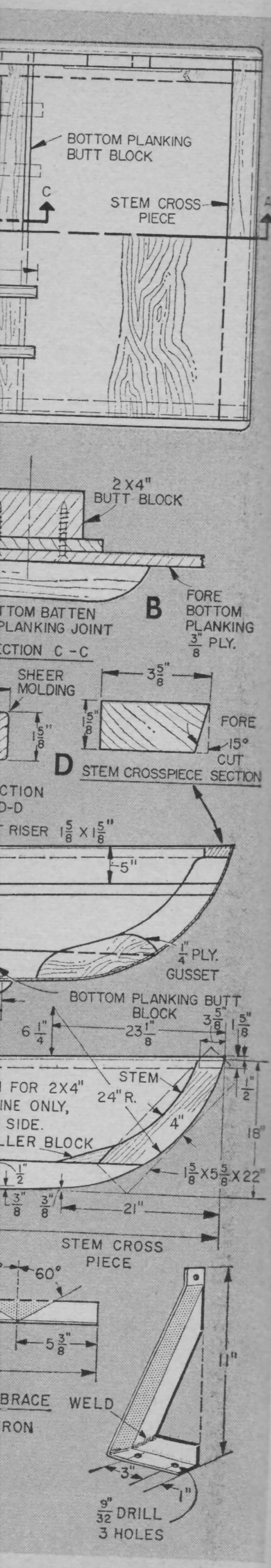
Mounting Hydrofoils

semble the aft foil comp
and fasten it to the ce

MATERIALS LIST—H

No. Req.	Size and Descrip
9	1⅝ x3⅝" x 10' fir or sp
1	1⅝ x 5⅝ x 48" fir or sp
1	¾ x 5⅝ x 60" fir or spru
2	¾ x 7⅝" x 8' fir or spru
1	¼" x 4 x 10' AB exterior
1	⅜" x 4 x 8' AA exterior
1	⅜" x 4 x 4' AA exterior
1	¾ x 15 x 48" AC exterior
1	⅛ x 1½ x 1½ x 36" ang
½ lb	1" wire nails
4½ gross	#8 x 1¼" fh screws
4 doz	#8 x 1¼" rh screws
4 doz	¼" washers for above
7 doz	#8 x 1½" fh screws
2 doz	#12 x 2¼" fh screws
2 doz	#12 x 2½" fh screws
4	¼ x 1¼" carriage bolts
2	¼ x 1½" machine bolts
2	⅜ x 8" carriage bolts
1 qt	Kuhls or Stay Tite Neopr
1 tube	Weldwood glue



x 1¼-in. *rh* screws and washers driven into the battens through the pilot holes drilled through the bottom planking as in Fig. 9.

Since a long-shaft outboard motor must be used with this hydrofoil craft, make the motor board 15 in. high as in Fig. 8F. Build up the board to a thickness of 1¼ in. by laminating ¾-in. solid lumber between two pieces of ¼-in. plywood. Fasten with glue and clamp until dry. Finish by sawing two 15° bevels along the bottom edge as in Fig. 8F. Drill the two ½-in. holes in the board to drain water splashed up behind the board. Make two wedge blocks as in Fig. 8F, and bolt the motor board to the transom with two ⅜ x 8-in. carriage bolts and two #12 x 2¼-in. *fh* screws.

Instead of using wood for the transom knees and locating them on the inside of the hull, we made them of angle iron and placed them on the outside as in Fig. 8. Make the two transom braces as in Fig. 8G so that you will have one right and one left hand brace. Bolt them to the transom at each side of the motor board as in Fig. 2, Part 1, with ¼ x 1½-in. machine bolts and to the bottom planking extension with ¼ x 1¼-in. carriage bolts.

For a finish, give the inside and outside of the hull one coat of white Firzite followed by one coat of enamel primer and one coat of marine enamel. Allow each coat to dry thoroughly and sand lightly before applying the next coat of paint. We used buff on the inside, white on the outside and red on the streamlined design on the side as in Fig. 6.

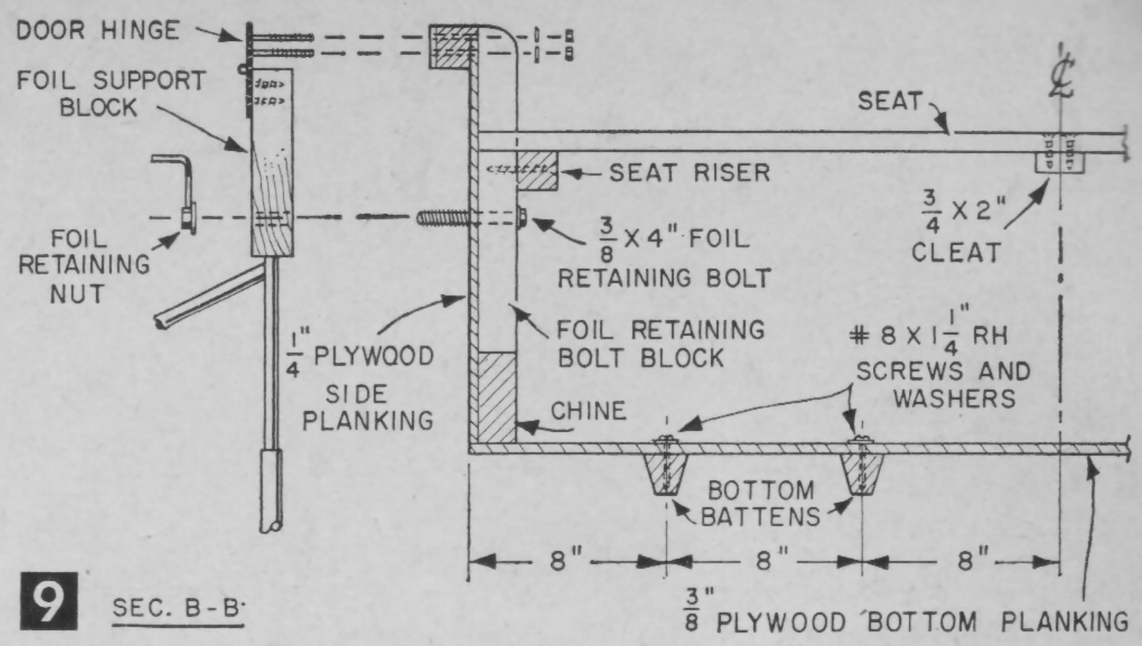
Mounting Hydrofoils on Boat. First assemble the aft foil complete with all brackets and fasten it to the center of the transom and aft planking extension as in Fig. 2, Part 1 with C-clamps. Have the boat up on saw horses at this time so that you can clamp your long-shaft outboard motor to the motor board. We used an Evinrude 18 hp., '59, long-shaft model in the #2 tilt pin setting and the aft foil just cleared the underwater exhaust on the motor. If the foil does not clear the exhaust of your outboard, re-clamp the foil brackets and drill new 9/32-in. holes for the ¼-in. bolts fastening the foil supports to the support brackets.

Use a protractor head with level to set the aft foil at the 4° angle of incidence with the hull bottom as in Fig. 9. Tighten the 5/16-in. bolt on the foil bracket to hold the foil at the 4° angle. Since it may be necessary to change the angle of incidence slightly, do not drill the 9/32-in. holes in the aft-foil supports to line up with the 9/32-in. hole in the aft-foil bracket until you have test run the boat.

Bolt the fore foils to the sheer moldings 58 in. forward of the transom as in Fig. 6, using a ¼ x 1⅝ x 18-in. wooden filler strip between the hinges and the sheer molding. Then drill a 13/32-in. hole at the center of the fore foil support block, 1½ in. from the bottom edge of the block as in Fig. 6, for the foil retaining bolt. Drill this hole through to the inside of the hull and insert the retaining bolt from the inside as in Fig. 9. A ¼-in. welding rod welded to the foil retaining nut as in Fig. 2, Part 1 will eliminate the need for having a wrench on hand each time the fore foils are raised and lowered.

Foil Adjustment. Since hydrofoils are still in the experimental stage, the only way you can achieve top performance from these hydrofoils is by trial and error methods during actual test runs. With a small boat such as this one the weight and location of the driver in the boat, or even the gas tank, can change the center of gravity enough to affect the angle of incidence of the foils. You may find that you will have to shift your setting position forward or backward slightly to trim the boat once it is up and riding on the foils.

The tilt-pin setting of the outboard motor



9 SEC. B-B

MATERIALS LIST—HYDROFOIL BOAT

No. Req.	Size and Description	Use
9	1⅝ x 3⅝" x 10' fir or spruce	framing, battens, molding
1	1⅝ x 5⅝ x 48" fir or spruce	stems
1	¾ x 5⅝ x 60" fir or spruce	motor board
2	¾ x 7⅝" x 8' fir or spruce	seats
1	¼" x 4 x 10' AB exterior fir plywood	sides, brackets
1	⅜" x 4 x 8' AA exterior fir plywood	aft bottom
1	⅜" x 4 x 4' AA exterior fir plywood	fore bottom
1	¾ x 15 x 48" AC exterior fir plywood	transom
1	⅛ x 1½ x 1½ x 36" angle iron	transom bracket
½ lb	1" wire nails	
4½ gross	#8 x 1¼" fh screws	
4 doz	#8 x 1¼" rh screws	
4 doz	¼" washers for above	
7 doz	#8 x 1½" fh screws	
2 doz	#12 x 2¼" fh screws	
2 doz	#12 x 2½" fh screws	
4	¼ x 1¼" carriage bolts	
2	¼ x 1½" machine bolts	
2	⅜ x 8" carriage bolts	
1 qt	Kuhls or Stay Tite Neoprene Sealer	
1 tube	Weldwood glue	

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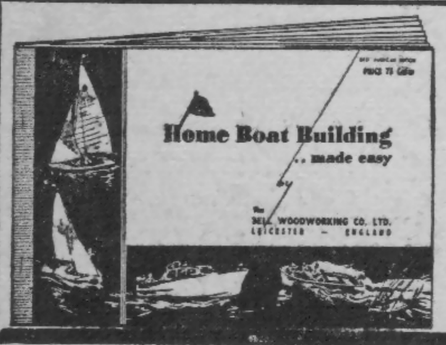

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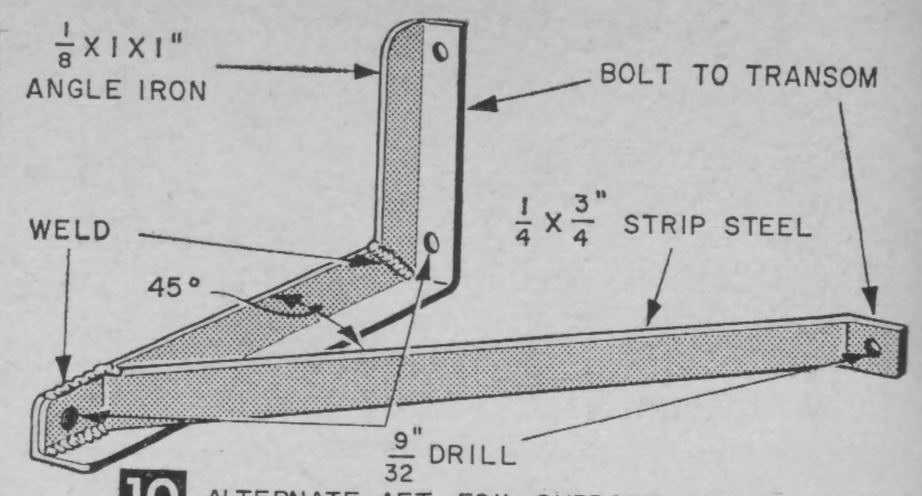

10 ALTERNATE AFT-FOIL SUPPORT BRACKET
2 REQ. I-RIGHT, I-LEFT

is also an important factor in achieving top performance. With the 15° motor board on this boat we found the #2 tilt-pin setting on the 18 *hp.*, long-shaft Evinrude we used, worked out best. If you use another make or model outboard motor you may have to change the tilt-pin settings. Do not attempt to use an outboard motor having a regular or stock length shaft.

If the aft foil will not lift the stern of the boat during a test run, increase the angle of incidence to about 4½°. If that does not help, vary the angle of the motor.

Lift-and-fall action of the aft foil indicates too great an angle of incidence. Reduce it, even if you must make it less than 4°.

The angle of incidence of the fore foils is not adjustable as is the aft foil. If the fore foils will not lift, the angle of incidence is not enough as compared to the aft foil. You can remedy this to a certain extent by setting back further toward the stern and thus shifting the center of gravity to allow the bow end of the boat to lift higher. With the foils adjusted properly, your boat should start raising off the water after a run of about 30 ft.

Installing Hydrofoils on Other Boats. Probably the only change you will have to make in adapting the aft foil to any other boat is to make a set of alternate aft-foil support brackets as in Fig. 10. Follow the same procedure used to mount the aft foil on the transom of our test craft.

A good rule-of-thumb to follow when mounting the fore foils is to locate the aft edge of the fore-foil support block at about the middle of the lengthwise dimension of the hull. Use three heavy C-clamps with suitable reinforcement blocks to protect the hull sides to temporarily fasten the foils to the hull. Then make a test run and use the trial and error method to find the best exact location at which to permanently fasten the fore foils.

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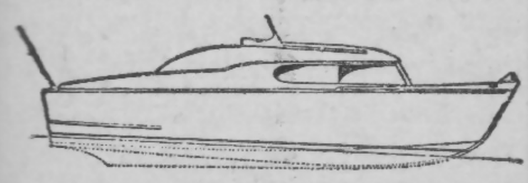

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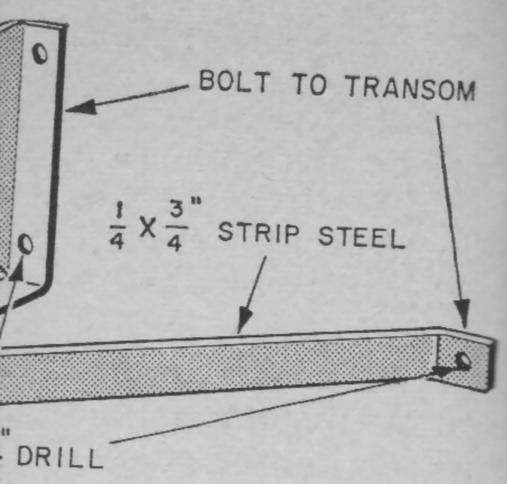

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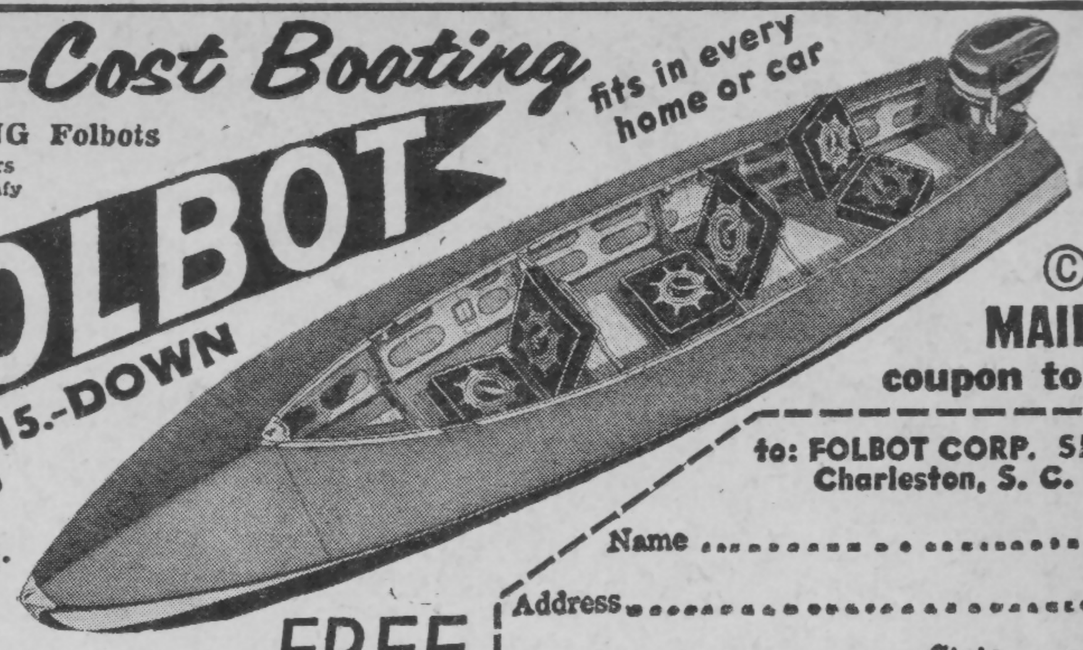

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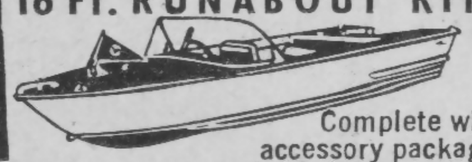

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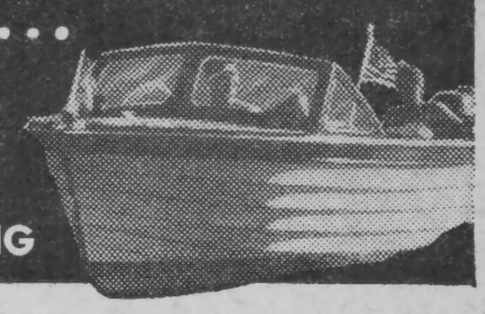

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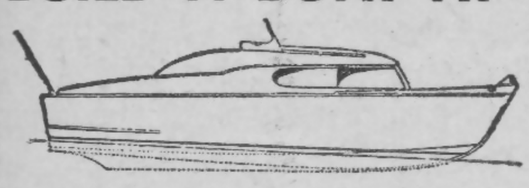

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One used accordion, a blower and some simple cabinetry are the basic ingredients of this chord organ.

Practically any make or size used accordion will do. Ours was a 1936 Wurlitzer model, and we have priced many other types at from $10 to $25 and up (see Materials List for sources.) A leaking bellows won't matter, because all you will use are the keyboard and reed sections. Key and chord button action should be good. Reeds are held in place by wax seals, so if any are loose or leaky, they can be resealed as in Fig. 6.

To operate the organ, air must be drawn across the reeds by a small constant-speed blower, of a constant-speed type so there will be no swell or fade to the sound (Fig. 3). The foot pedal and bleeder valves in this design regulate their air flow, thus enabling you to control volume, as well as vary the ratio of sound between the treble and bass sections.

The blowers specified in the materials list will work well. Or, if you have a small one on hand, you can test it by sealing up the inlet, and connecting it with rubber tubing to a glass tube immersed vertically in a glass of water. A blower that pulls at least ½-in. of water up the tube will operate the organ; one that will pull ½-1½-in. of water will give you controlled volume on the whole range.

Preparing the Accordion. First remove the accordion bellows, which are usually held in place by pins or screws through the end frames (Fig. 4). If any of the reed holders are loose you can repair them by melting and resealing with a soldering gun (as in Fig. 6). If you intend to permanently install the accordion parts in the organ, you can make an optional improvement, by shellac sealing the unused reed in each holder (the one not covered by a leather flap visible on the outside—see Fig. 7).

The mounting boards for the accordion keyboard use rubber seals to prevent air leaks (Fig. 2). Remember that the blueprint drawings are based on the Wurlitzer 120 Bass accordion we used, and you should adjust the mounting board dimensions, and also the overall cabinet length and width, to fit the accordion you obtain.

With the reed frames removed, check the backs of the accordion end housings to make sure they are perfectly flat, filing the plastic, if necessary, to make sure of a good seal. Then block up the keyboard section, so the keys are parallel to the bench, and check the back angle, as in Fig. 5. Our accordion measured 60°, so if your measured angle is different, be sure to change construction as required. (Note: If you are using an expensive accordion, you may want to preserve its use as an accordion. With many makes you can improvise a wood fitting equal in size to the bellows frame, which will enable you to remove both treble and bass sections quickly from the organ).

Now block up the keyboard section to the right of the chord button section, working on a flat bench so that the back surfaces are in the same plane and spaced 1½-in. apart. Make the mounting board of ¾-in. plywood, three inches longer than the overall length of the two accordion sections, and three inches wider than their back width. Cut holes to clear the reed holders and other projecting parts. Then bevel the top and bottom edges of the mounting board to match the angle measured earlier.

With the mounting board blocked up on the bench, place the accordion sections in position, and pencil the outlines of the backs. Along the top of each section, nail a length of ½-in. square stock to act as a top guide, and allowing a loose fit for the accordion sections, nail a section of 1-in. stock outside the bottom pencil marks. Shellac the front surface of the mounting board, allow it to dry a day, and then apply sponge rubber weather stripping inside the pencil marks, as in Fig. 9.

The accordion sections are held in place by the grille panels, which are, in turn, fastened into the panel mounting spacers with screws. Place the accordion sections in their proper positions on the mounting plate, and tape them temporarily. Outline a set of fitted spacer blocks which will locate the front grille panels just right to grip the accordion sections, and so that they clear the accordion valve lifters when the keys are depressed.

Air Chambers. Make the two sides and center divider of the air chambers of ¾-in. solid wood as in Fig. 9, with the 60° angle (or the angle of your accordion) cut at the front. Nail the dividers to the mounting board and cut the two pieces of ½-in. plywood which fit in between. Make the slots and sliding valve parts as in Figs. 10 and 11.

The lever linkage made of strap metal provides a means of adjusting the volume of air flowing through slot C and thus you can control the amount of sound produced by the bass chord reeds while playing the instrument. Bleeder valves A and D give you a means of reducing the air suction to either the treble or bass sections, so that you can adjust your organ to play very softly or for any desired volume.

Make the air passage channel (see Fig. 9) of ¾-in. square strips of wood and hardboard. It serves to draw the air as much as possible from the center of each reed chamber. Before final assembly, sand the valve parts and channels carefully, and round the sharp corners of each air slot with a wood rasp to prevent air "hissing." Cover the top of the reed chambers with ¼-in. plywood or hardboard.

Blower Box. To minimize motor vibration, the blower box is supported by a shelf covered with rubber, and is sealed to the air chambers with weather seal. Make the box of ¾-in. lumber (Fig. 13) and use screws for easy disassembly. The spring-return pivoted cover is the main volume control for both treble and bass sections; with no foot pedal pressure, there will be no sound. When you press the foot pedal all the way down, sound volume will be maximum. Select a spring for the pivoted cover and adjust so it gives you the right "feel" for the foot pedal.

Cabinet Construction. Walnut, mahogany, pine, or maple can be used for the cabinet. Construction details are shown in the blueprint drawings. The 24-in. legs used are stock items (see Materials List).

Since the dimensions of your accordion may not match those of the accordion shown in the blueprint, place your completed reed chamber and blower box on a flat surface, and check the inside clearance dimensions for length and width of the cabinet parts. The cover of the cabinet folds back, and its bottom edge is beveled at 30°. This bevel, which is also cut on the front board, provides clearance for playing the treble keys. The bottom of the front board is cut out for legroom and decorative effect. Fasten the top boards from inside with small angles, or desk-top fasteners to eliminate unsightly nail marks.

Filter Grille Panels. The front grille panels do a double job. They clamp the accordion sections in place, and they also filter the incoming air. Since the accordion reeds will clog if dust accumulates, back these filter grilles with heavy cotton cloth, or use a decorative grille cloth. The grille shown in Fig. 12 is available from plastic molding houses, and the same kind of material can also be obtained from interior decorators, and some electrical supply houses. Cut and bevel the front panels to fit. Fasten these panels with wood screws for easy removal, applying just enough pressure to hold the accordion sections firmly in place.

Construct the foot pedal as in Fig. 14, and connect it to the volume control valve with flexible wire or chain. It should be adjusted so that the spring provides a 3 to 5-lb. pull for comfortable pedal action. The bent ends of the music stand rod (Fig. 15) fit in holes drilled inside the fold-back cover.

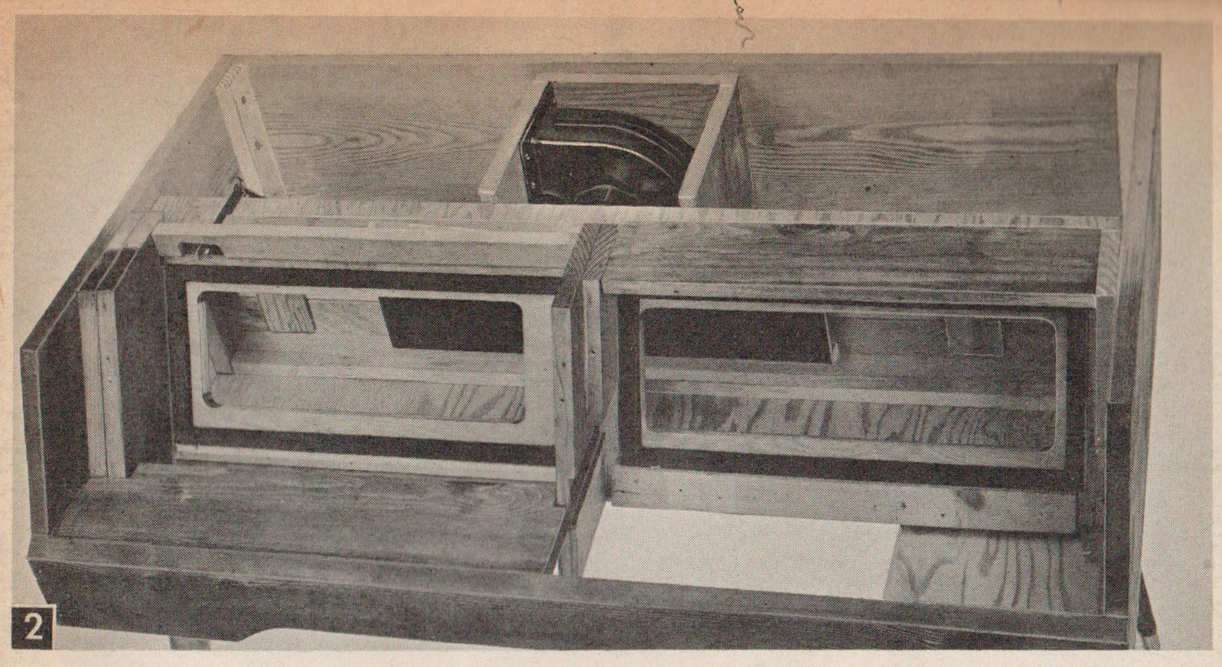
The chord chart shown in (Fig. 16) can be added for quick identification of the bass chord buttons.

Simplified accordion instruction books, available in most music stores, will help you to master playing technique quickly.

MATERIALS LIST — CHORD ORGAN

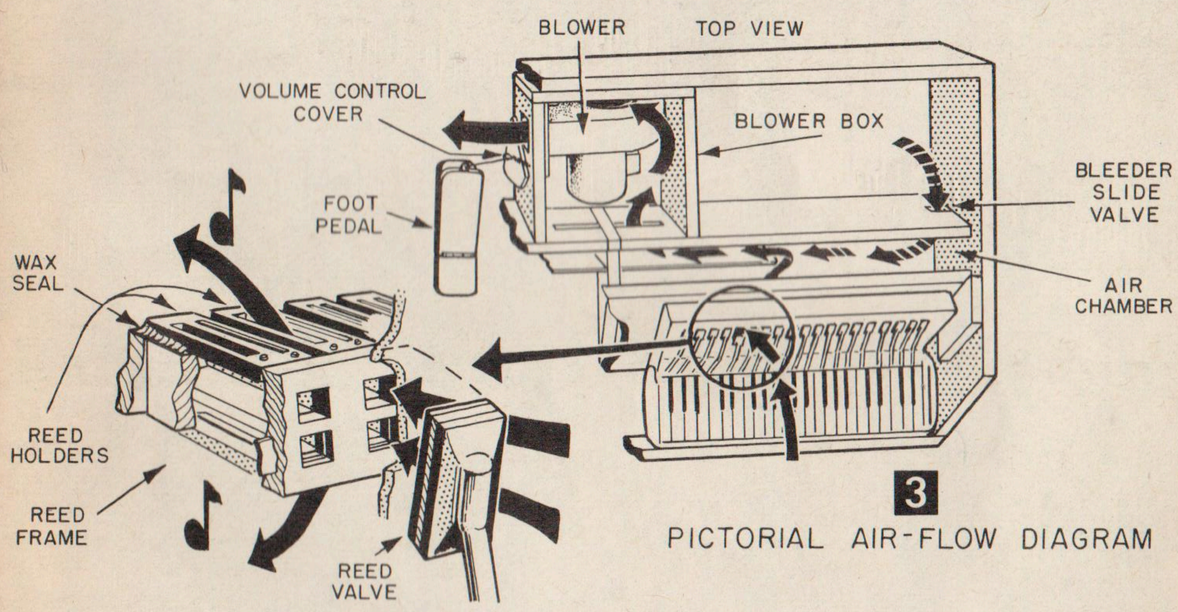
No. Req'd	Size and Description
1	used accordion 120 Bass, 3-Octave, available through local music stores, instrument repair shops, accordion dealers (such as Italian Accordion Co., 7600-A South Cottage Grove Ave., Chicago 19, Ill.)
1	Dayton #2C610 blower from Dayton dealers or from R. W. Turnbull, 4 Ferncliff Rd., Barrington, N. Y., for about $16. Special blower kit, also available from R. W. Turnbull for $23.75, provides considerably more control and sound volume
4	24" table legs with mounting plates (available for $5.25 postpaid from Siegal Lumber Co., Dept. SM, 4815 West Grand Ave., Chicago 39, Ill.)
1	¾ x 10⅝" x 12' pine, mahogany or walnut (cabinet)
1	¾ x 11⅝ x 48" pine, mahogany or walnut (lid)
1	¾ x 7⅝" x 8' pine, mahogany or walnut (covers)
1	¾ x 9⅝" x 10' pine (blower box, air chamber and cleats)
1	¾ x 24 x 32" fir plywood (leg boards and air chamber)
1	¾ x 10 x 40" fir plywood (air chamber)
1	½ x 18 x 20" fir plywood (air chamber)
1	¼ x 18 x 24" fir plywood (air chamber)
1	10¾ x 23½" plastic louver, white, ⅝" cells, ($3 postpaid) from S & J Electric Supply, 5119 N. Winchester Ave., Chicago 40, Ill.
2	cloth filters for above. Heavy flannel trimmed to fit
1	5/16 x ¾" x 10' roll, self sticking sponge rubber weather seal (auto supply stores)
1	3/32 x ½ x 24" steel strap (control lever)
1	⅜ O.D. 3¾" tension spring (blower box)
1	½ x 48" cabinet hinge (cover)
4 doz.	#7 x 1¼" fh wood screws
1 doz.	corner angles, or desk top fasteners
1	3/16 x 36" steel or aluminum rod (music rack)

Finishing nails, shellac, cabinet glue, wood sealer, stain, wax, foot pedal cable and scrap hardwood strips.



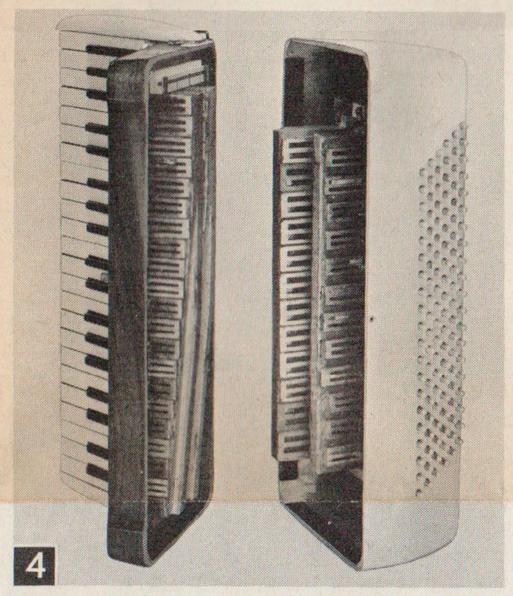
2

Gaskets of black rubber weather strip seal accordion sections to mounting board and to air chambers. Note blower mounted in box in rear.



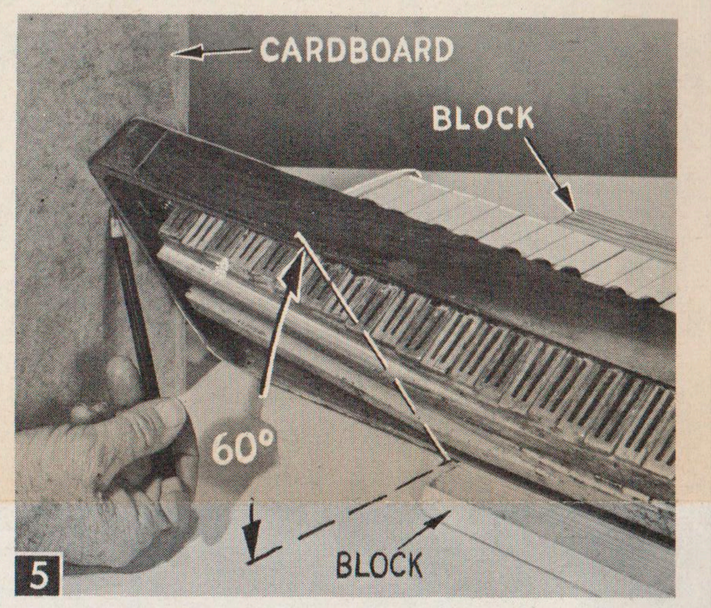
3 PICTORIAL AIR-FLOW DIAGRAM

When foot pedal is pressed, pivoted volume control cover opens. Air is pulled through blower box, air chambers and finally through the reeds which produce the musical tones. The reed valves are connected to accordion keys.



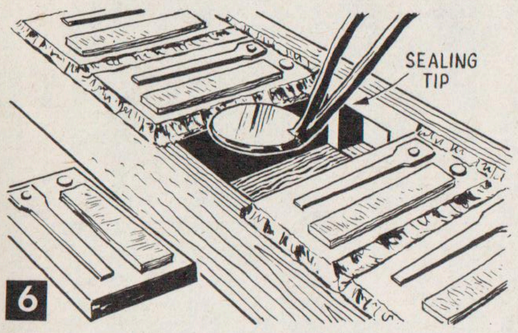
4

Here are the key and reed sections—the only parts you need from the used accordion. Bellows is not needed.



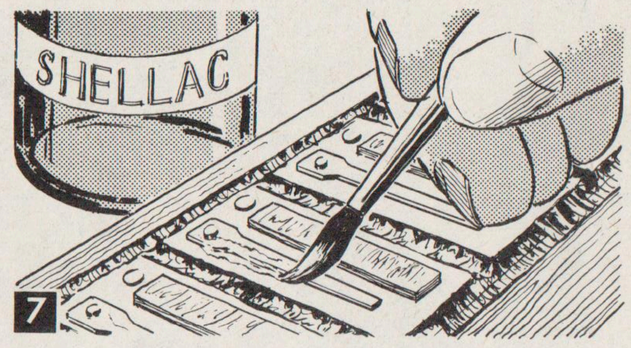
5

To measure mounting angle of accordion, block up accordion section parallel to bench and draw the angle on a verticle board.



6

Use a plastic sealing tip on your soldering gun to melt wax and re-seal any loose or leaky reed holders.



7

If you plan to permanently install accordion parts, you can get quicker tone response and avoid air leaks by sealing unused reeds with shellac.

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ELECTRIC CHORD ORGAN

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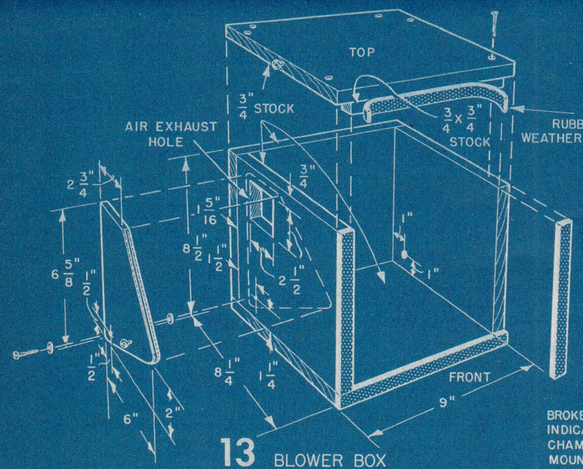
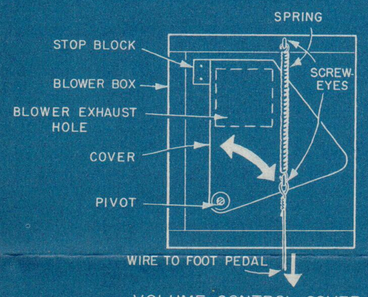
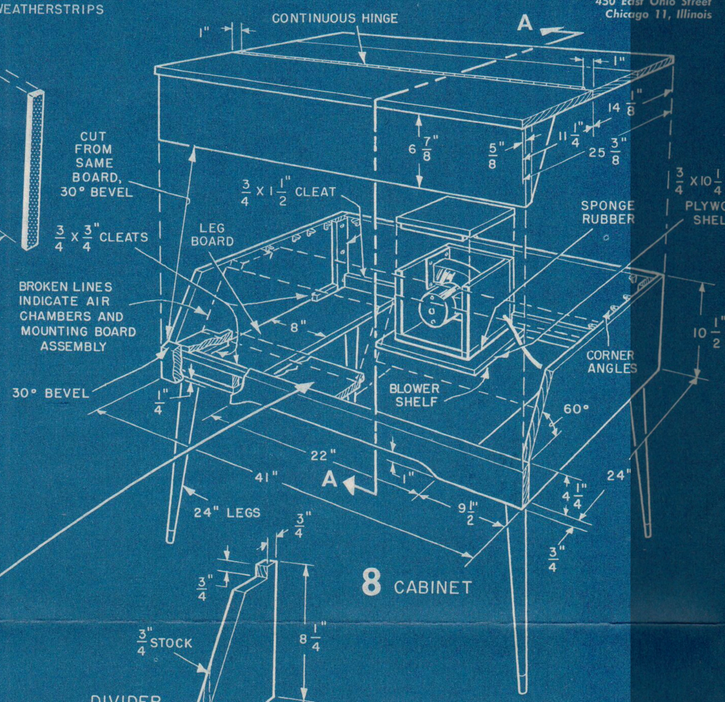


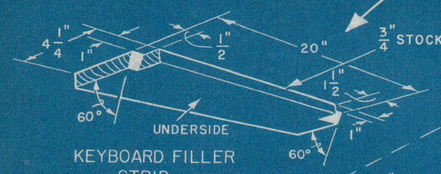
13 BLOWER BOX



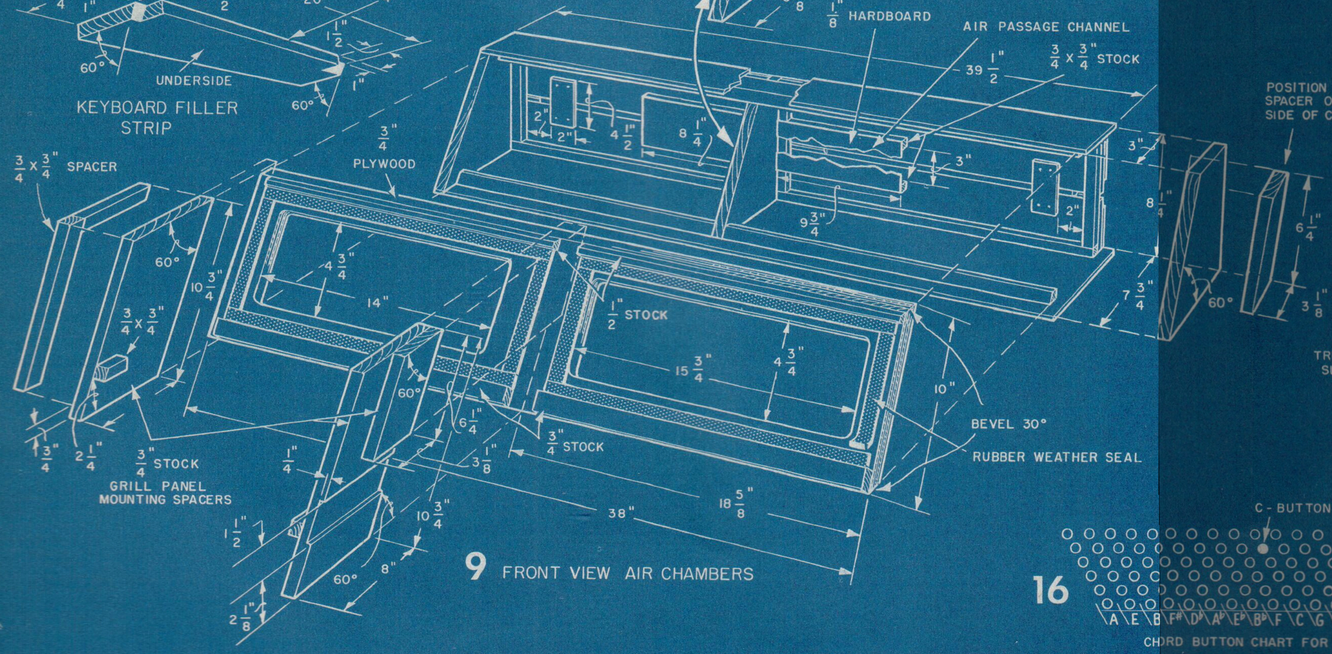
VOLUME CONTROL COVER



8 CABINET

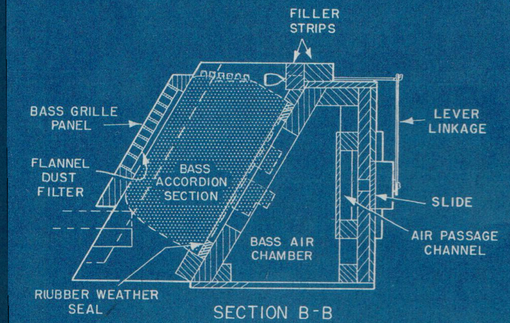


KEYBOARD FILLER STRIP

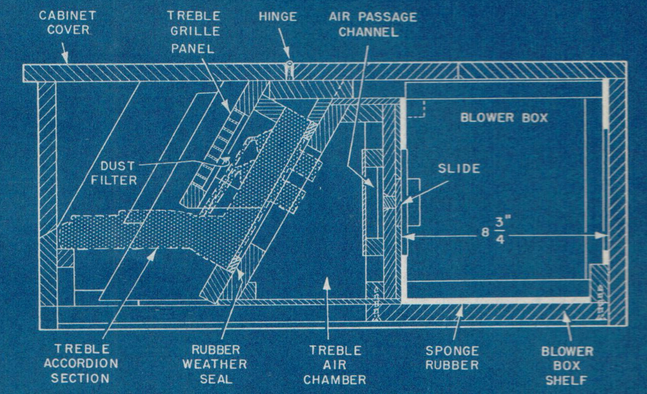


9 FRONT VIEW AIR CHAMBERS

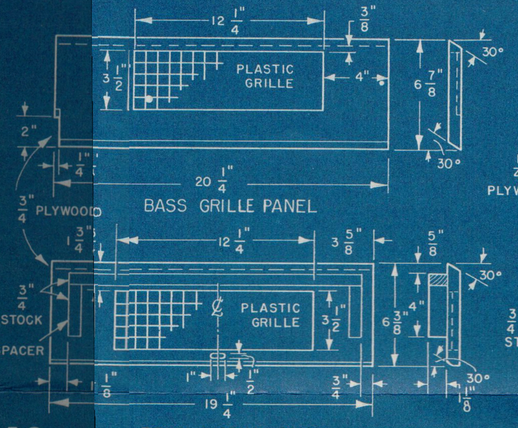
12

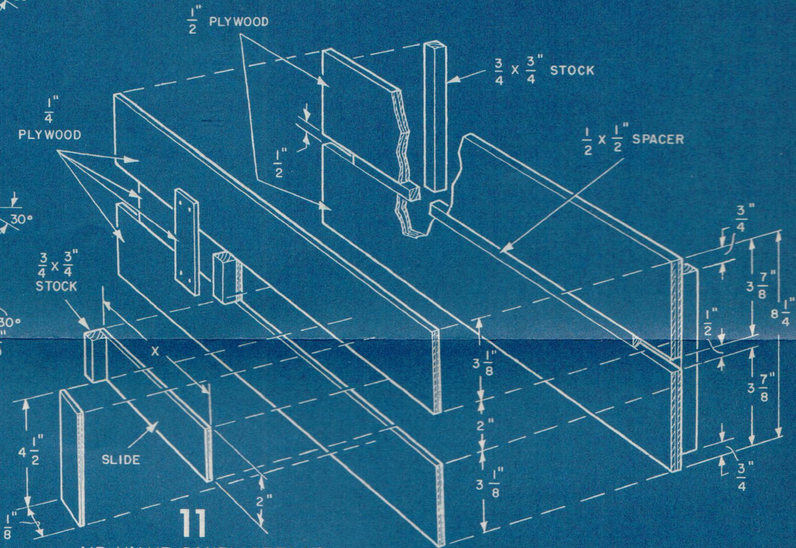


SECTION B-B

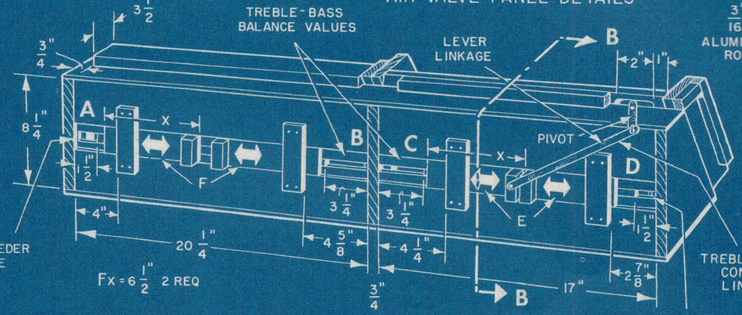


SECTION A-A

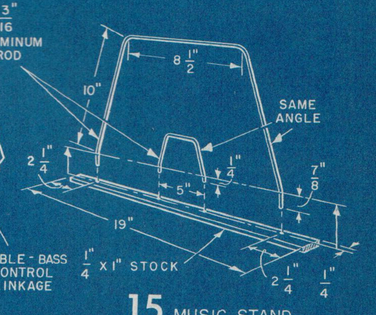




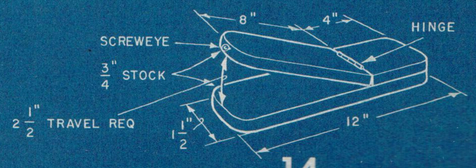
11 AIR VALVE PANEL DETAILS



10 REAR VIEW AIR CHAMBERS



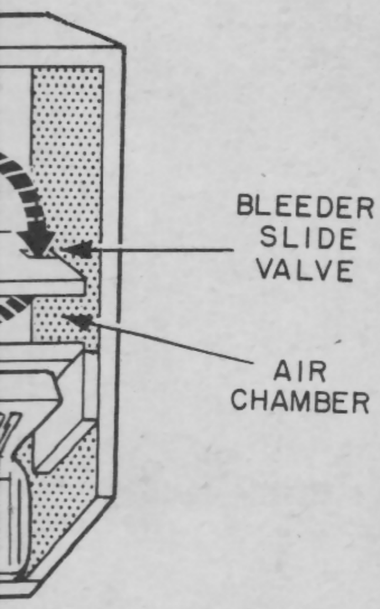
15 MUSIC STAND



14 FOOT PEDAL

16 CHORD BUTTON CHART FOR STANDARD 120 - BASS ACCORDION

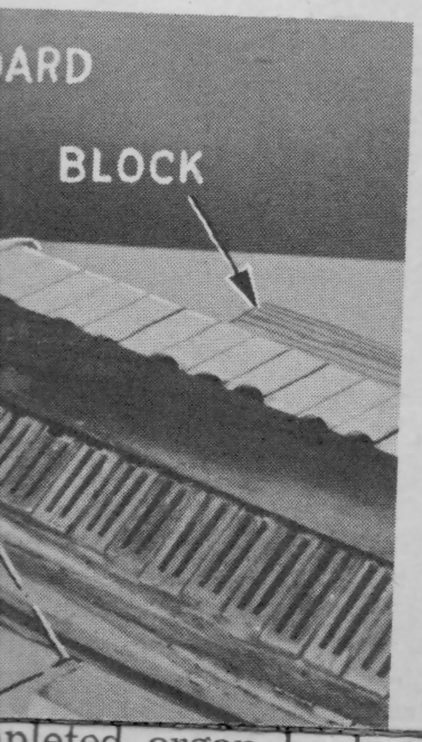
g board and to air



3

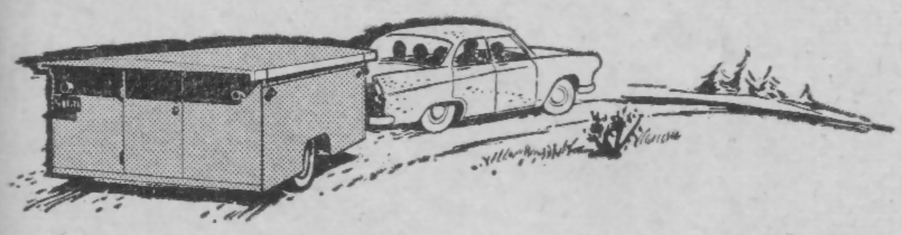
FLOW DIAGRAM

hrough blower box,
The reed valves are



pleted organ he has

Proof of its sturdy construction, this photo was taken after Sid Troolin's camping trailer had covered 10,000 miles on two vacation trips.



Craft Print Project No. 305

Fold-Up Vacation Trailer Sleeps Six

By SIDNEY W. TROOLIN

FIVE minutes after you reach a camping site, you can have this trailer set up to provide indoor sleeping or eating accommodations for six people.

When you figure the cost of motel accommodations and restaurant meals for a family of six you can quickly realize the cost saving advantages a trailer of this type offers. You'll also save several hundred dollars by building it yourself.

When it is folded down for traveling, there is plenty of space in the trailer body to store all vacation items that otherwise clutter the car and take up usable seating space.

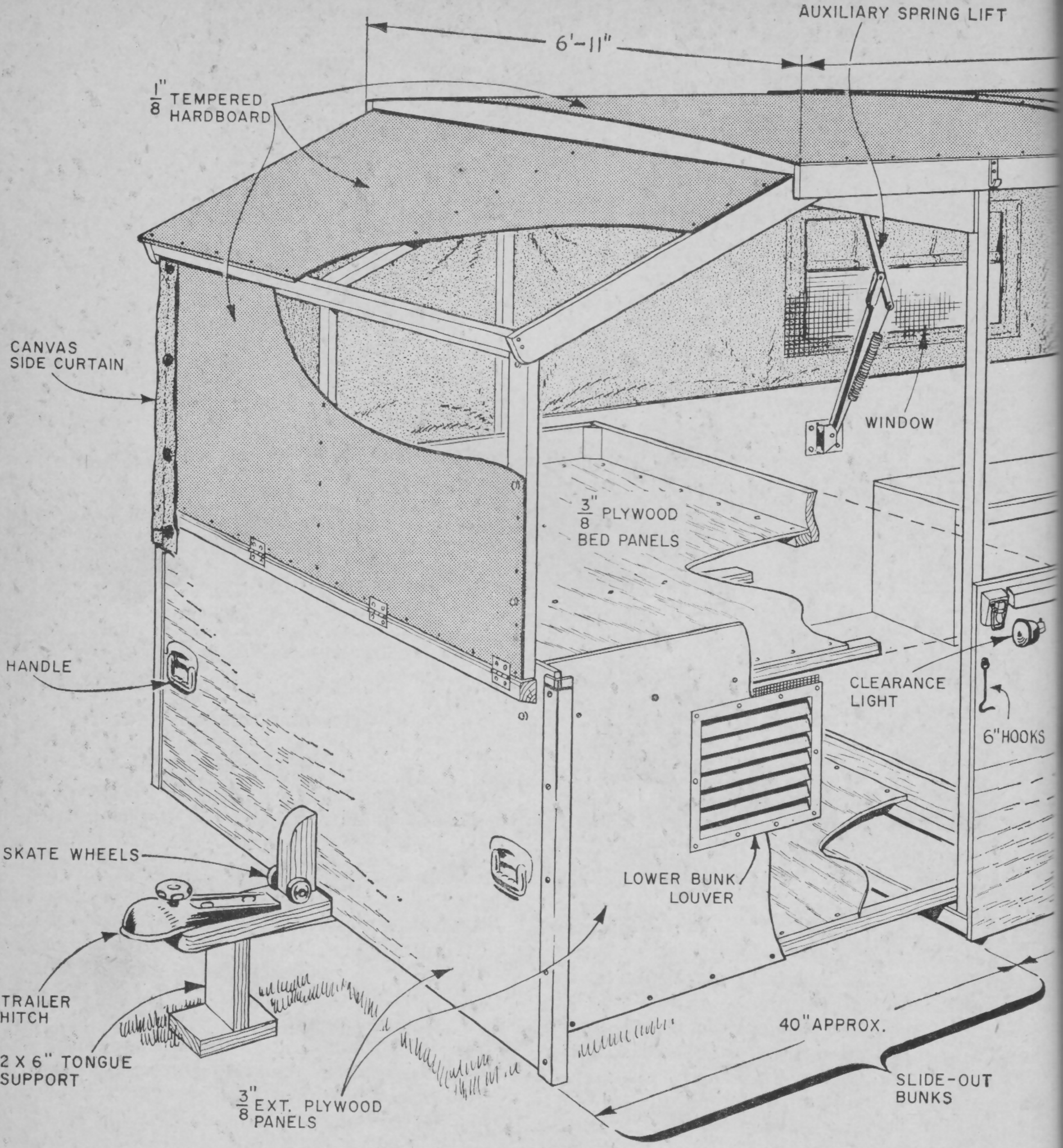
The design has been carefully worked out in subassemblies so the amateur builder can use his garage or car port to assemble the parts out of the weather. You start construction with the running gear.

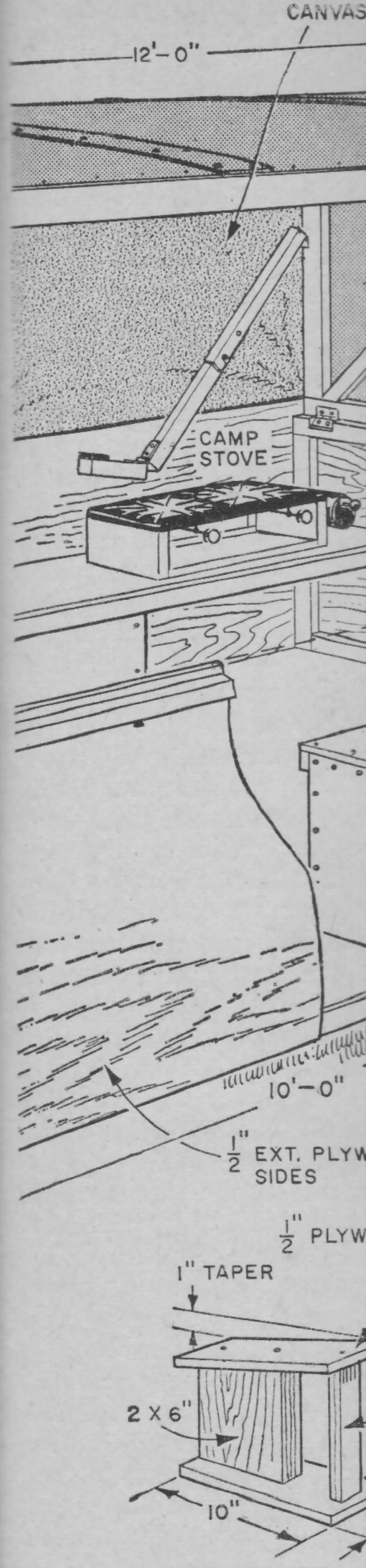
Trailer Axle. We used the steering knuckles with wheel spindles from a '50 Nash front end and bolted them to a home-made axle (Fig. 8) for our trailer running gear. Steering knuckles from other makes of cars can also be used provided they can be bolted or welded to the flat surface of the trailer-axle end plate. If possible, select steering knuckles, hubs and wheels of the same size as your car so you will have a spare in case of a flat.

When ordering the 4-in. channel iron for the trailer axle (see Materials List), have it cut to the 53½-in. length with a power hacksaw, rather than torch cut, so that the ends will be smooth and square. Also have the spindle supports and end plates cut to size.

Before welding the axle parts together, drill the $^{13}/_{32}$-in. holes in the channel iron and end plates. Then center the spindles of the steering knuckles on the end plates 5⅝ in. from one end as in Fig. 8A. Locate and tap the four holes in the end plates from the holes in the steering knuckles. Use hardened cap screws to bolt the knuckles to the end plates. Apply *Lock-tite* to the threads of the cap screws to prevent them from loosening.

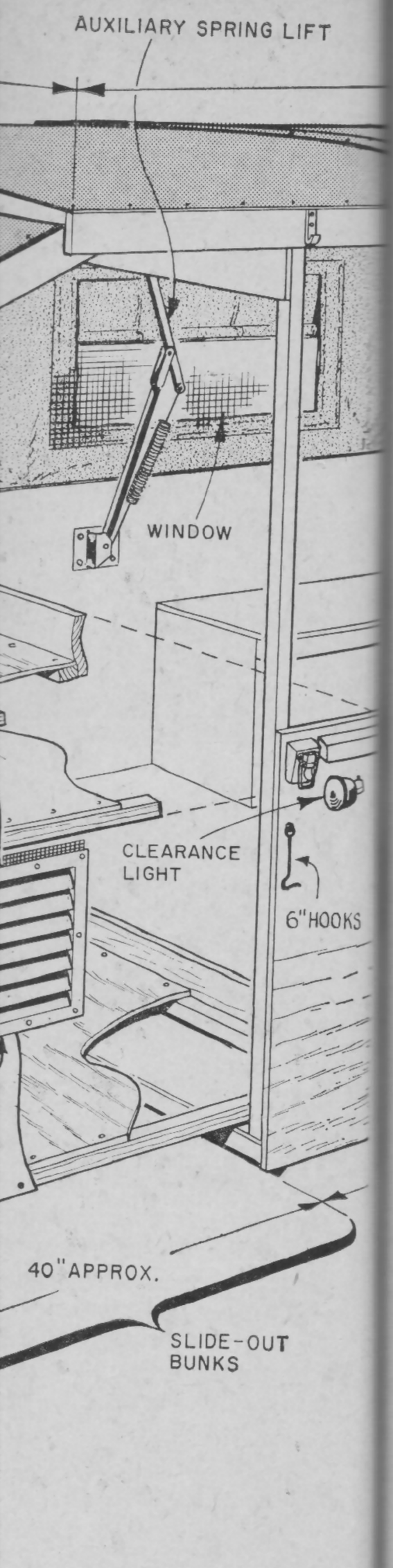
Now, assemble the support gussets and end plates to the channel iron with C-clamps and bar clamps and check the alignment of the spindles with a straightedge or flat surface. Then tack weld the parts together and remove the clamps. To prevent distortion of the end plates due to the heat of arc welding, tack weld two lengths of scrap ¾-in. pipe from the top of the end plates to the channel,

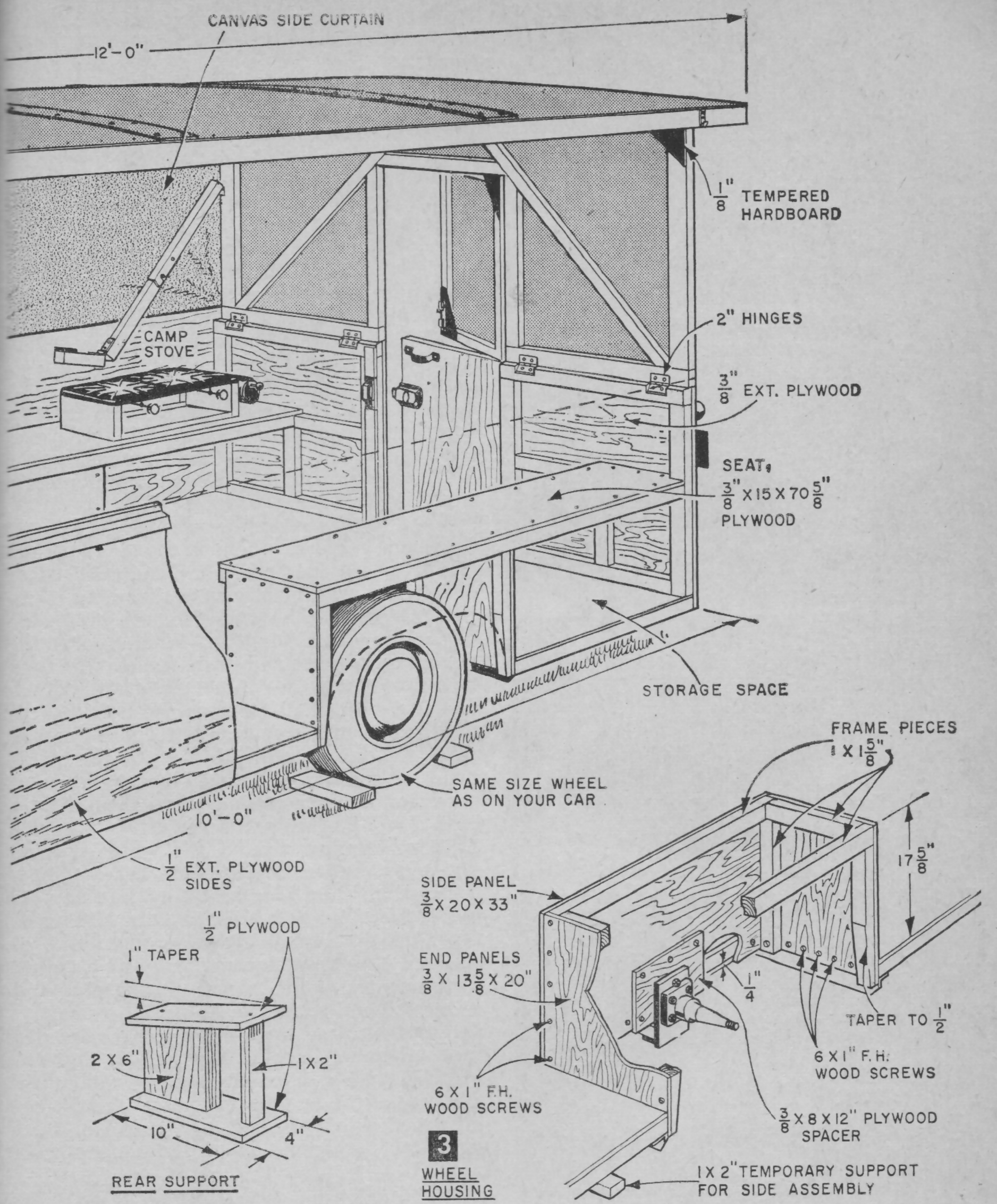




MATERIALS LIST—FOLD-UP CAMPING TRAILER

No. Req.	Size and Description
1	1½ x 4 x 53½" channel iron, structural (axle)
2	½ x 4 x 8" steel bar stock (axle)
2	½ x 2 x 4" steel bar stock (axle)
1	Used car front axle steering knuckles with spindles (axle)
2	8:00 x 15" wheels and 4-ply tires (axle)
5	½" x 4 x 10' exterior fir plywood (floor and body)
6	⅜" x 4 x 8' exterior fir plywood (body and bed)
6	⅛" x 4 x 8' tempered hardboard Masonite (roof)
14	2 x 4" x 10' fir (body framing)
1	2 x 6" x 14' clear fir (tongue)
2	1 x 6" x 8' pine (beds)
2	1 x 6" x 12' clear redwood (roof stringers)
5	1 x 6" x 8' clear redwood (rafters and framing)
1	⅛ x 1¼ x 1¼" x 10' angle iron (bed and hinge brace)
3	⅛ x 1¼ x 1¼ x 80" angle iron (cross braces)
2	3 x 6" x 16 gage steel (hinged brace bracket)
2	1¼ x 3" x 16 gage steel (sliding bolt plate)
1	3/16 x 2 x 84" strip steel (tongue)
6 doz	4-40 x ½" *rh* machine screws with nuts (roof)
1 doz	5/16 x 3¼" carriage bolts (cross braces)
1	⅜ x 3" carriage bolt (tongue)
1	⅜ x 3½" carriage bolt (tongue)
3	⅜ x 4" carriage bolts (tongue)
3	⅜ x 4½" carriage bolts (
2 gross	#8 x 1½" *fh* screws (bod
12	#8 x 1" *fh* screws (axle s
1 gross	#6 x ¾" *fh* screws (roof)
¼ lb.	¾" nails (roof)
1 lb	2" cement-coated nails
1 lb	1½" cement-coated nails
1 pr	6" gate hooks (front hing
2 pr	2" gate hooks (bed)
4	draw-bolt catches or hasp
2 pr	3" flap strap hinges (roo
7 pr	1-9/16 x 2" butt hinges (
1 pr	2½ x 2½" brass hinges
1	night latch door lock set





3	3/8 x 4 1/2" carriage bolts (tongue)
2 gross	#8 x 1 1/2" fh screws (body)
12	#8 x 1" fh screws (axle spacer)
1 gross	#6 x 3/4" fh screws (roof)
1/4 lb.	3/4" nails (roof)
1 lb	2" cement-coated nails
1 lb	1 1/2" cement-coated nails
1 pr	6" gate hooks (front hinged panels)
2 pr	2" gate hooks (bed)
4	draw-bolt catches or hasps (roof)
2 pr	3" flap strap hinges (roof support)
7 pr	1-9/16 x 2" butt hinges (ends and upper door)
1 pr	2 1/2 x 2 1/2" brass hinges (lower door)
1	night latch door lock set (lower door)
2	1 1/2" wide sliding bolt locks (front panel)
3 rolls	5/16" thick x 3/8" wide rubber car weatherstrip
2	.12 x 12" house ventilating louvers (bed)
4	1 3/8" dia. rubber-backed metal gliders (bed)
1	trailer hitch without jack
1 lb	Weldwood glue
10 yds	48" wide treated canvas (#60A9796H Montgomery Ward)
5 doz	Dot Fastener sets (sides)
4 ft	24" wide fiber glass screening (window)
4	20" long jacket-type zippers (window)
1	stop and tail light with license bracket
1	stop and tail light
2	2 1/2" amber clearance lights
2	2 1/2" red clearance lights

wood (roof stringers)
ood (rafters and framing)
angle iron (bed and hinge brace)
angle iron (cross braces)
(hinged brace bracket)
el (sliding bolt plate)
teel (tongue)
e screws with nuts (roof)
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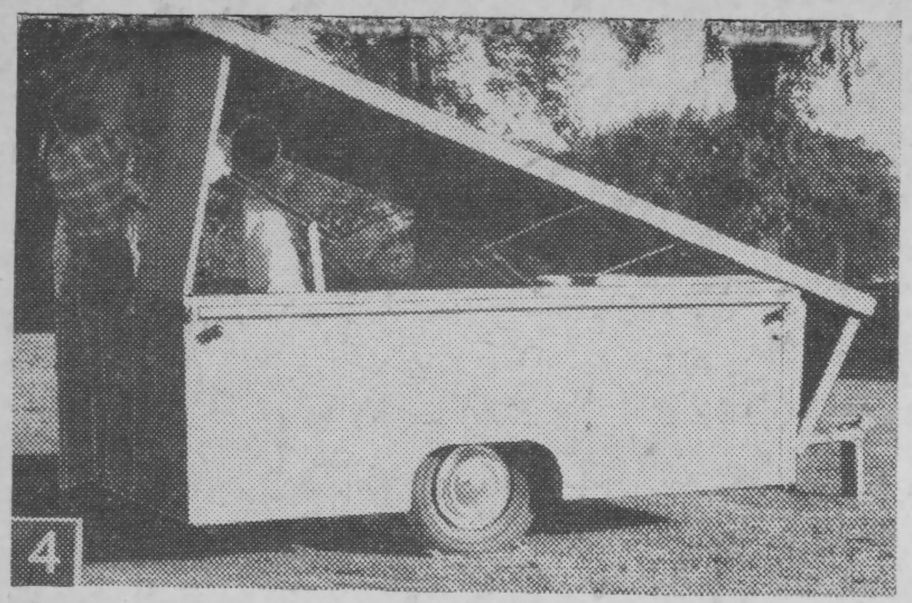

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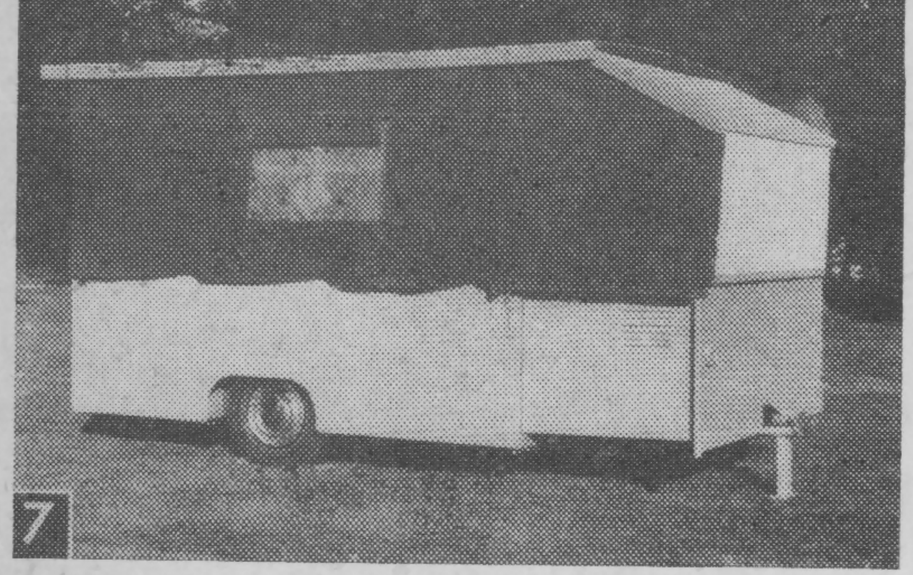


7

Fig. 4. To set up the trailer, have your helper crouch just inside the door and swing up the rear panel as you lift the roof. Then, going to the front end of the trailer . . . Fig 5. raise this end of the roof and hold it there by pushing up on the hinged end panels while you swing up the roof support. Finally . . . Fig. 6. pull out the bunk beds which will automatically raise the end panel to the vertical position. For sleeping . . . Fig. 7. hang up the canvas sides with snap fasteners provided.

as in Fig. 8B, before making any continuous welds. Remove the pipes after completing the welding.

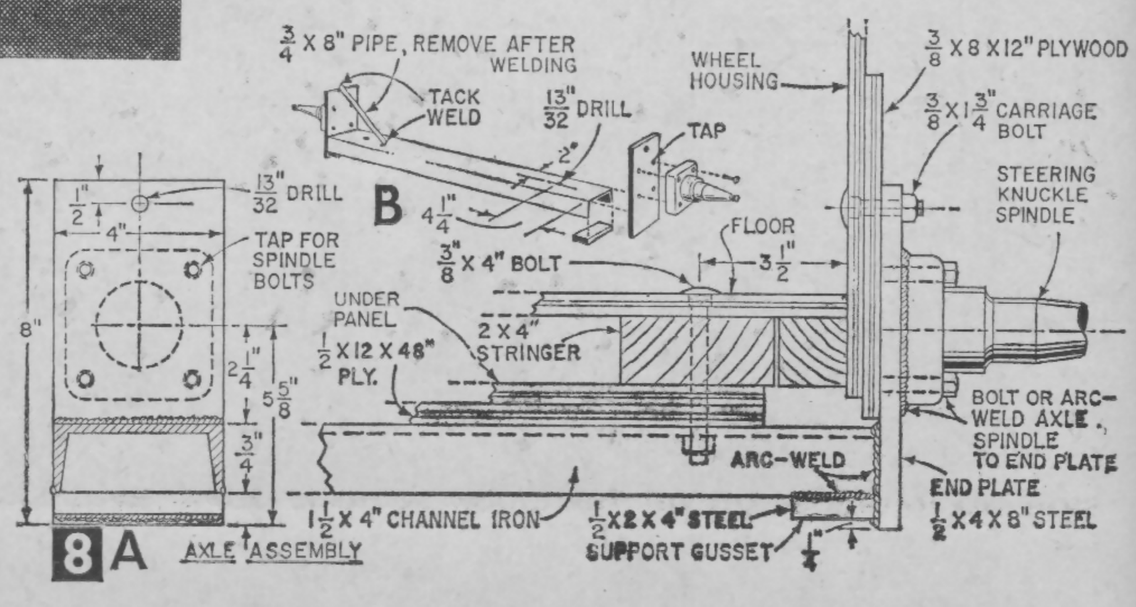
Floor Assembly. First rip the 10-ft. long panels of ½-in. plywood to obtain the two 40-in. wide by 10-ft. long floor boards. Then lay out and saw the 14 x 33-in. cut-outs to provide clearance for the trailer wheels. Be sure to make these cutouts on opposite ends of the floor boards so you will have one right and one left hand floor board.

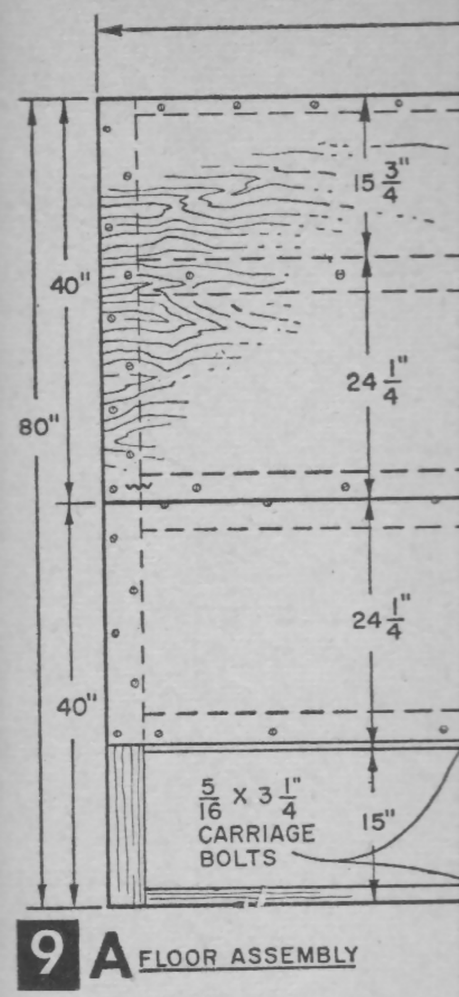
Place the 2 x 6-in. tongue plank on the garage floor and mark a centerline along its entire length. Then cut and assemble the other 2 x 2- and 2 x 4-in. framing members (indicated with dotted lines in Fig. 9A) on each side of the tongue. Toenail or use corrugated fasteners to temporarily hold these framing members in alignment. The 2 x 2-in. pieces (actually 1⅝ x 1⅝ in.) that go along the 10-ft. ends and around the wheel cutouts are best installed later.

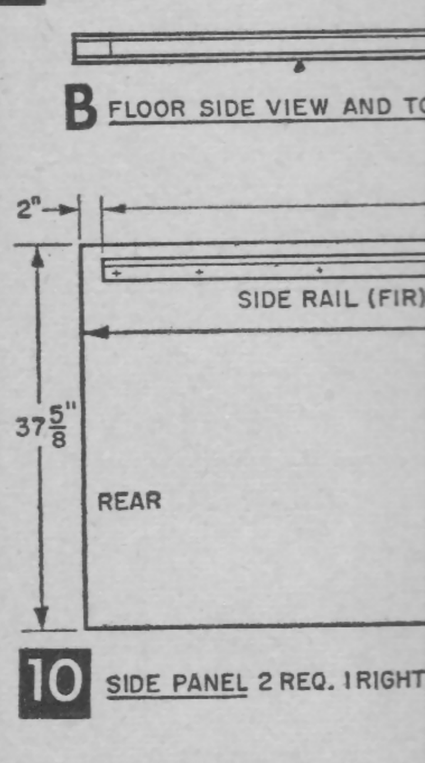
Place the two floor boards on the framing members, centering them on the tongue. Then check to see that the front and rear edges are in line and flush with the framing members. Be sure to have the smooth or A side of the plywood facing up. When everything checks out square and flush, remove the floor boards and coat the contacting surfaces of the framing with glue. Replace the floor boards and fasten with a few nails to hold them in place. Then, referring to Fig. 9A for placement of screws, drill and countersink pilot holes for the screws and drive them tightly with a wood brace and screwdriver bit. The 2 x 2-in. framing around the wheel cutouts and end can then be installed.

To make this floor assembly into a rigid box section that will resist twisting and bending, turn the assembly upside down and install a 4 x 10-ft. under-panel of ½-in. plywood to the center of the framing, using glue and screws spaced as in Fig. 9A.

Bolt the three angle-iron cross braces to the underside, locating them as in Fig. 9A. Place ½ x 1⅝ x 16-in. strips of plywood under the ends of the angle iron for spacers. To reinforce the tongue, bolt the 3/16 x 2-in. steel strap to the underside of the tongue with







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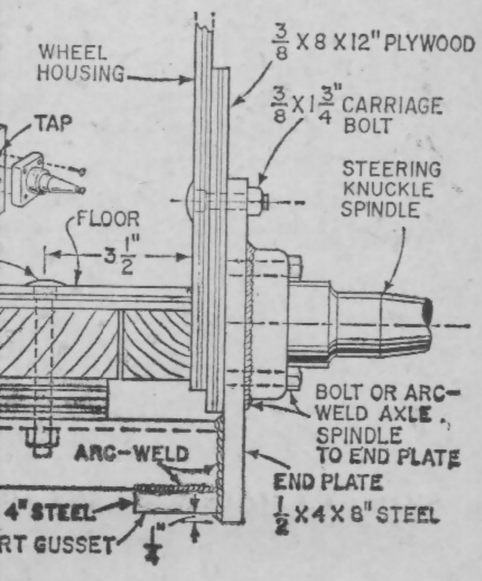
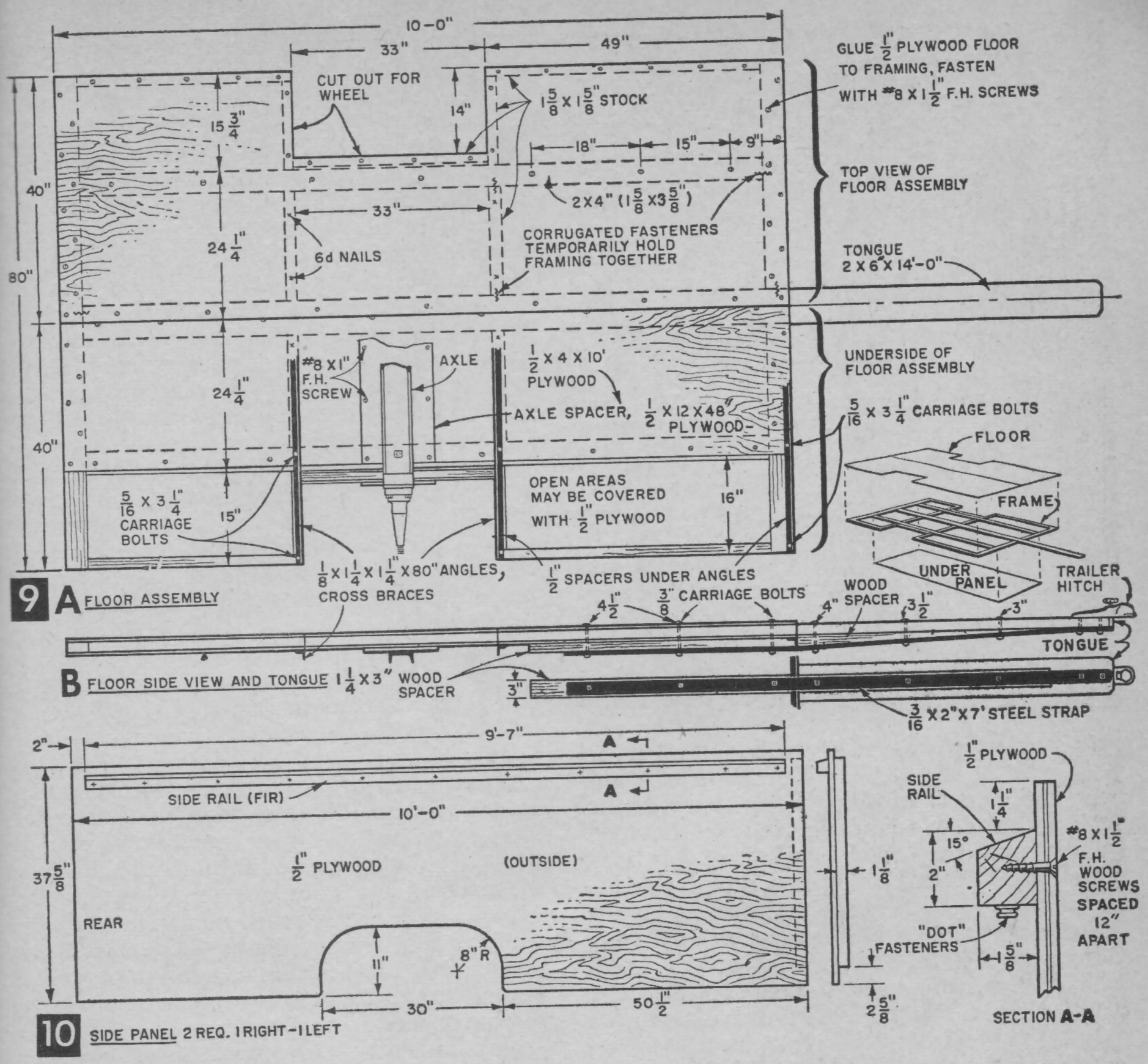




9 A FLOOR ASSEMBLY

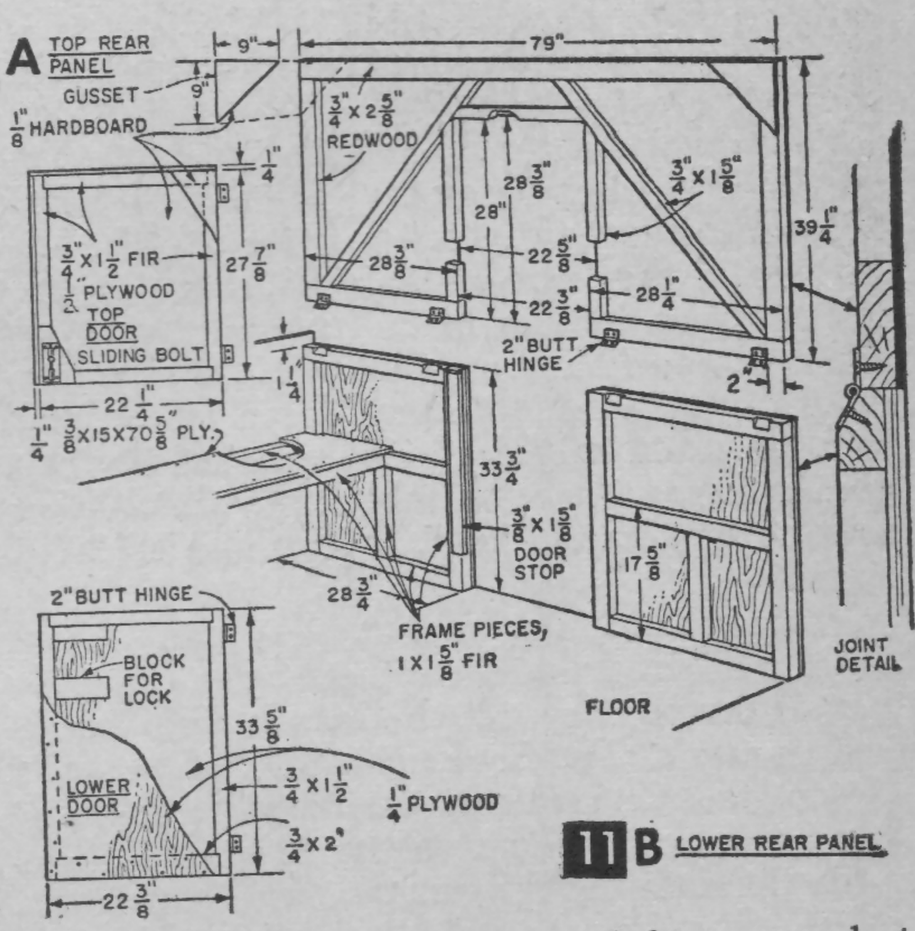
B FLOOR SIDE VIEW AND TONGUE

10 SIDE PANEL 2 REQ. 1 RIGHT-1 LEFT

⅜-in. carriage bolts spaced as in Fig. 9B and the two bolts used to fasten the trailer hitch to the tongue. Note that a straight and tapered strip of 1¼ x 3-in. wood is placed between the tongue and steel strap for spacers to form a beam and strengthen the tongue.

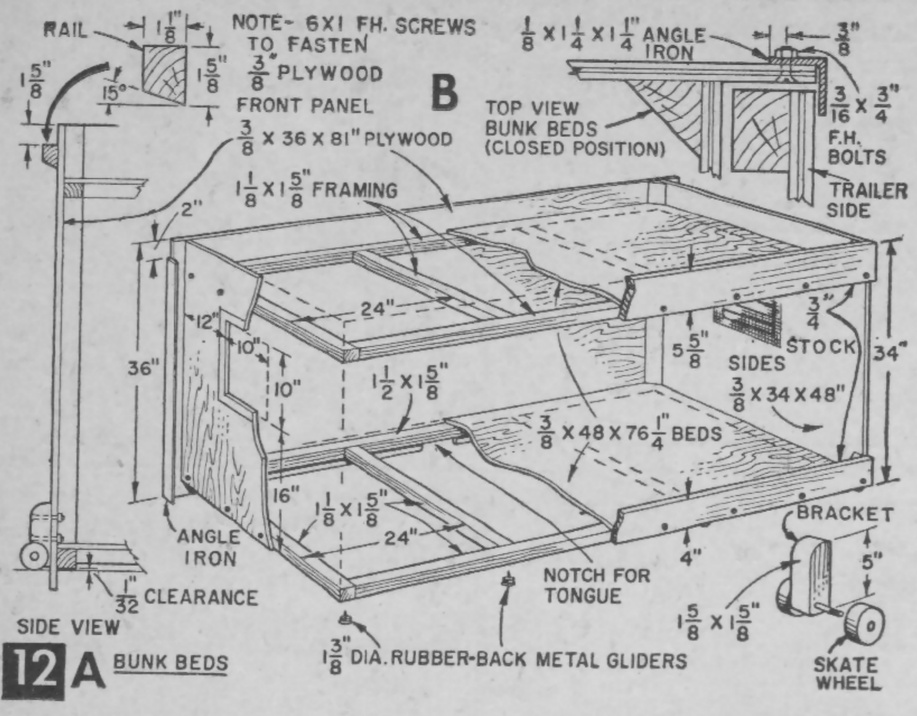
Now, while the floor assembly is in the upside down position, is the time to bolt the trailer axle in place. First glue and screw the ½-in. plywood axle spacer (Fig. 9A) to the under-panel, centering it at the wheel cutouts. Then position the axle so the spindles are centered across the wheel cutouts and equi-distant from the right and left sides of the floor assembly. Also check to make certain the axle is square with the tongue and floor sides before bolting the axle to the floor assembly as shown in Fig. 8A. Give the entire underside of the floor assembly one coat of house primer followed by one coat of porch and deck enamel.

Trailer Body. With the assembly turned right side up, block it up off the floor. Check the floor surface of the assembly with a level to



11 B LOWER REAR PANEL

make certain it is not twisted, because whatever shape the assembly is in when the side and back panels are installed will be locked



12 A BUNK BEDS

in place.

To get all of the 3/8-in. plywood pieces needed to make the wheel housings (Fig. 3), the bunk beds (Fig. 12A) and the lower rear body panels (Fig. 11B), use five 4 x 8-ft. panels of 3/8-in. plywood. Lay out all of the pieces on the five panels before sawing out any parts. Rip saw the 1 x 1⅝-in. framing pieces for the wheel housing from 2 x 4-in. stock. Then assemble the wheel housings to the cutouts on the floor assembly with #6 x 1-in. *fh* screws as in Fig. 3. Be sure the front and rear end panels of the wheel housings are flush with the sides and square with the floor. Do not cover the wheel housings at this time. Slide the 3/8 x 8 x 12-in. plywood spacer between the axle and wheel housing as in Fig. 3 and drill through both spacer and housing to insert the 3/8-in. bolt (Fig. 8A).

Next, lay out and saw the side panels (Fig. 10) to shape. Rip the side rail and stud for the side panel from 2 x 4-in. stock and fasten to the panels as in Fig. 10 so that you will have a right and left hand side for the trailer body.

To hold the sides flush with the bottom of the floor during assembly, temporarily nail two scrap pieces of 1 x 2-in. stock to the underside of the floor assembly so they project out about an inch as in Fig. 3. Have someone assist you in lifting and holding the side panels into position while you drive a few nails to keep them in place. Then fasten the side panels to the floor assembly and wheel housings with #8 x 1½-in. *fh* screws spaced 10 in. apart.

Before installing the rear body panels, nail the 1 x 1⅝-in. framing to them as in Fig. 11B. Install the panels with the bottom edges resting on top of the floor assembly. Use #8 x 1½-in. *fh* screws to fasten them to the side panels and nail them to the floor with 2-in. nails through the framing.

We extended the wheel housing covers to the rear panels as in Fig. 2 and used them as seats and a place to put the two burner camp stove. If you prefer, the wheel housings only can be covered and other chair and cabinet arrangements worked out to suit your individual needs.

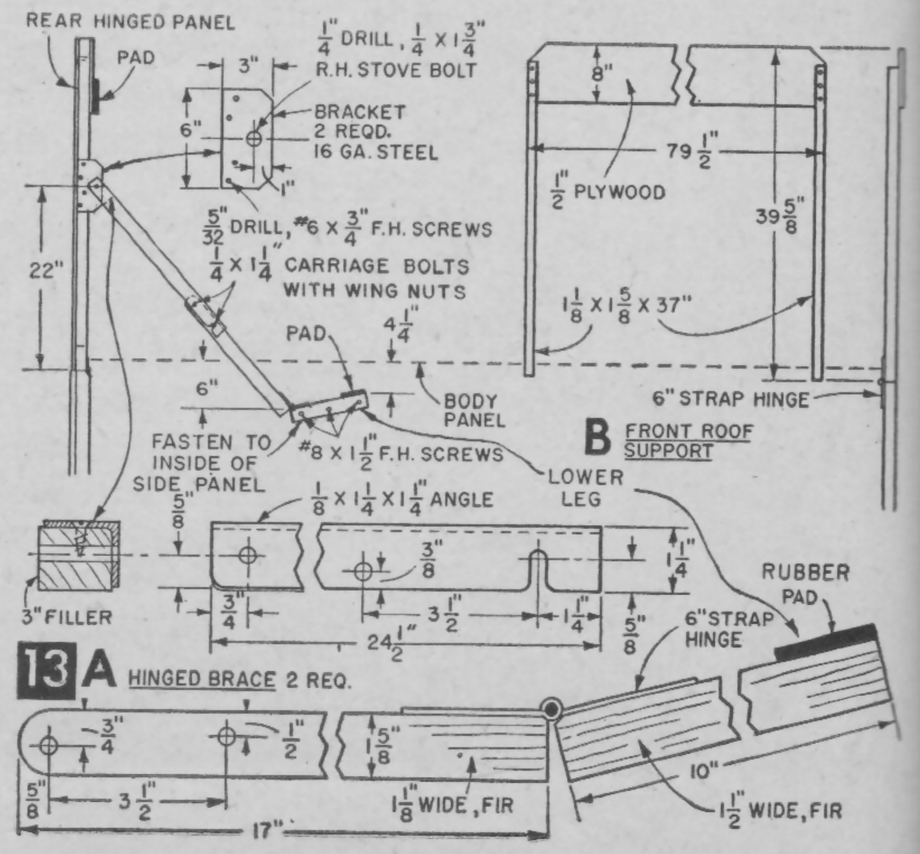
The Bunk Beds are a large box-like structure that slides out of the front of the trailer body as in Fig. 6, when setting up the trailer for camping use. Make the bunk bed assembly from 3/8-in. plywood and framing ripped from 2 x 4-in. stock as detailed in Fig. 12A. The two metal louvers installed in the sides of the bunk bed structure will provide ventilation for the lower bunk bed. When installing the louvers, place pieces of wire window screening over the louvers so screening will be "sandwiched" between louver and the opening in the bunk bed sides.

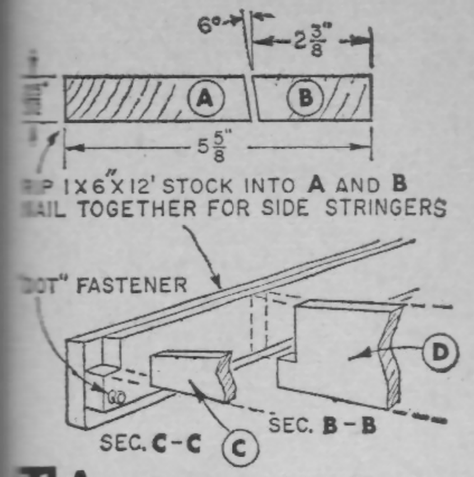
Mark and cut out the bottom edge of the bunk bed front to clear the tongue. The angle irons bolted to the ends of the bunk bed front panel (Fig. 12B) protect the front corner of the trailer body and hold the body sides in place when the trailer is folded down for traveling.

Attach a pair of folding handles to the front of the bunk beds for use when pulling the bed section out as in Fig. 2.

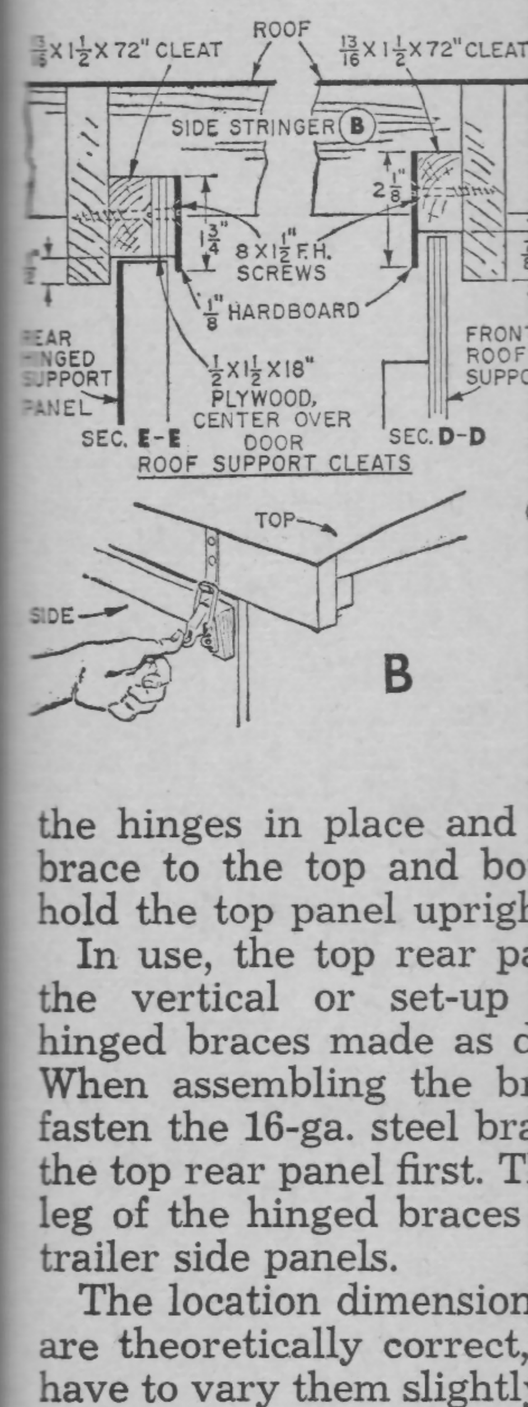
Next, make the top rear panel as detailed in Fig. 11A. Rip the 4 x 8-ft. sheet of *Masonite* hardboard to the 39¼-in. width first, and save the strip left over for use on the roof later. Cut out the door opening as you did the wheel cutouts so as to preserve the piece for making the door. When assembling the framing to the hardboard, note that only one vertical door frame member is flush with the hardboard. This is the side the door will be hinged on. Use glue and ¾-in. brads to fasten the hardboard to the framing.

Now fasten the 2-in. butt hinges to the inside of the bottom framing and have someone hold the top rear panel in place on the rear trailer body panels while you mark them for the hinge cutouts as in Fig. 11B. Then screw





4 A ROOF ASSEMBLY



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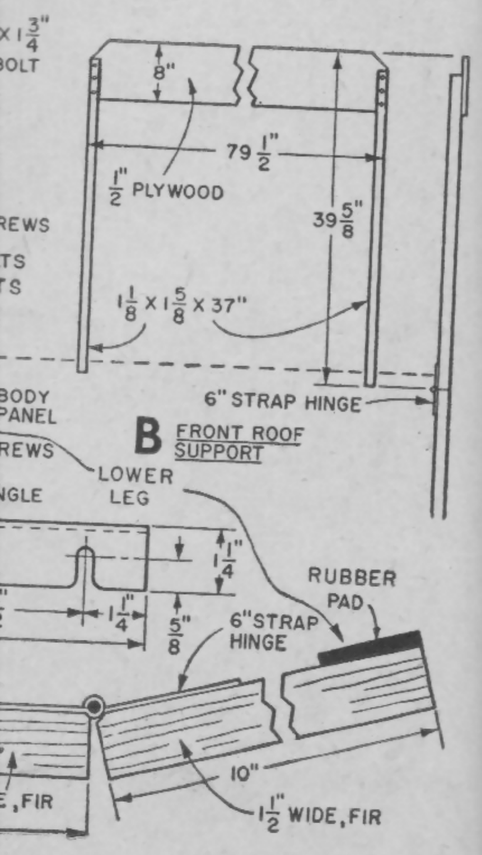
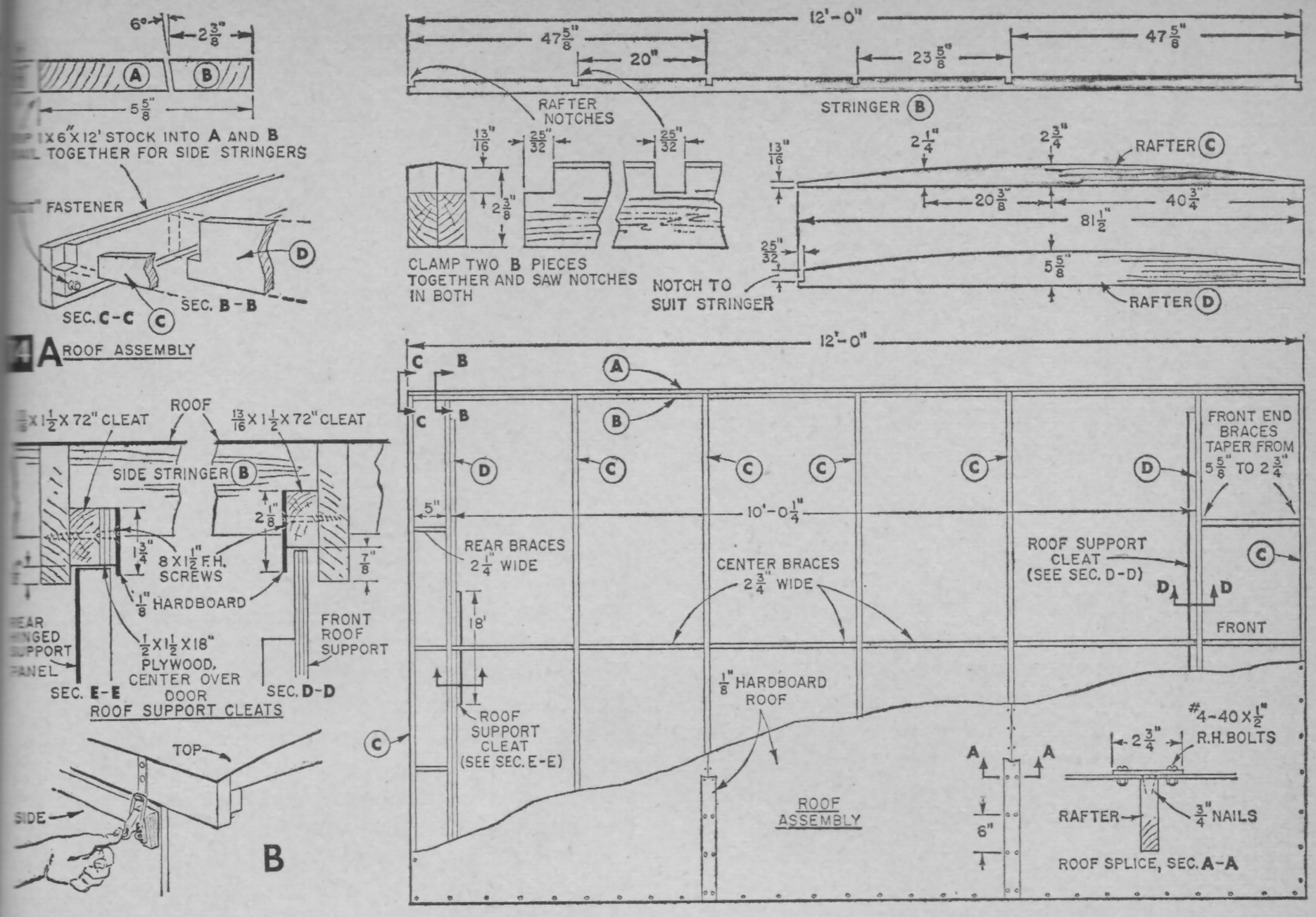




the hinges in place and clamp a temporary brace to the top and bottom rear panels to hold the top panel upright.

In use, the top rear panel is supported in the vertical or set-up position with two hinged braces made as detailed in Fig. 13A. When assembling the braces to the trailer, fasten the 16-ga. steel brackets to the ends of the top rear panel first. Then fasten the lower leg of the hinged braces to the inside of the trailer side panels.

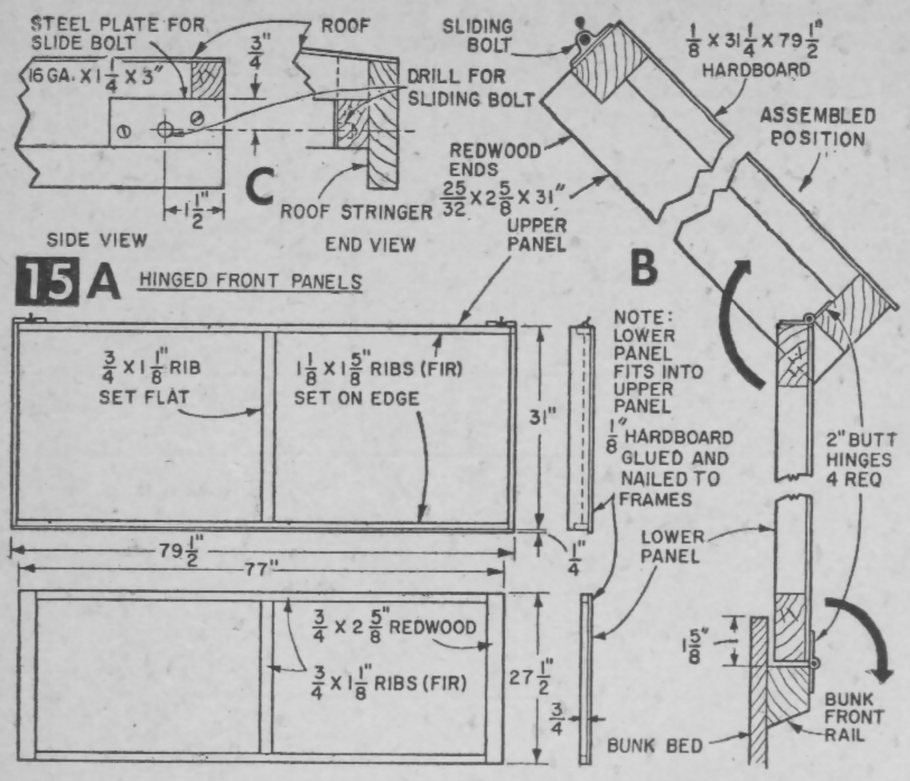
The location dimensions shown in Fig. 13A are theoretically correct, but since you may have to vary them slightly, don't permanently fasten the lower legs until you have raised and lowered the rear panel to try the braces for correct action and proper fit in the "down" position. In the correct "down" position, the collapsed brace should rest on the lower leg of the brace with the top rear panel leaning down slightly to clear the rafters of the roof. Outer edge of panel should be approximately two inches below top edge of sides. When you have the brace positioned correctly, fasten the lower leg with three #8 x 1½-in. *fh* screws from the outside of the trailer sides.

To support the front of the trailer roof, make the hinged roof support as in Fig. 13B and attach to the studs at the inside front ends of the side panels with 6-in. strap hinges. In the down position, this support should rest on the top of the bunk bed structure.

The Roof Assembly (Fig. 14A) is your next item to build. Starting with the stringers, rip two 12-ft. lengths of 1 x 6-in. redwood at a 6° angle as in Fig. 14A for the A and B stringers. Clamp the B stringers together and notch them both at the same time for the C rafters. Then remove the clamps and fasten the B stringers to the A stringers with glue and 2-in. nails, clinching them on the inside.

Now lay out and saw one of the C rafters to shape. To aid in drawing the curved line for the top of the rafter, bend and hold a strip of plywood against nails driven into the rafter stock at the 13/16, 2¼ and 2¾- in. measured points. Then, using this rafter as a pattern, lay out and saw the other C and D rafters. Notch the ends of the D rafters for the B stringers and assemble the C and D rafters to the stringers as in sec. B-B, Fig. 14A, with glue and one 2-in. nail at each joint. Cut the front, rear and center rafters to size and nail them in place between the rafters. Then check the framework by measuring diagonally across the curves to see if it is square.

Before installing the ⅛-in. hardboard roof, plane or file with a rasp all the rafter-to-stringer joints to make certain their top surfaces are flush so that the hardboard will make good contact with all frame members. Apply the first sheet of hardboard flush with the end rafter and fasten with about a dozen ¾-in. nails to hold it in place. Then install the other two sheets and trim off the overhang along the stringers.

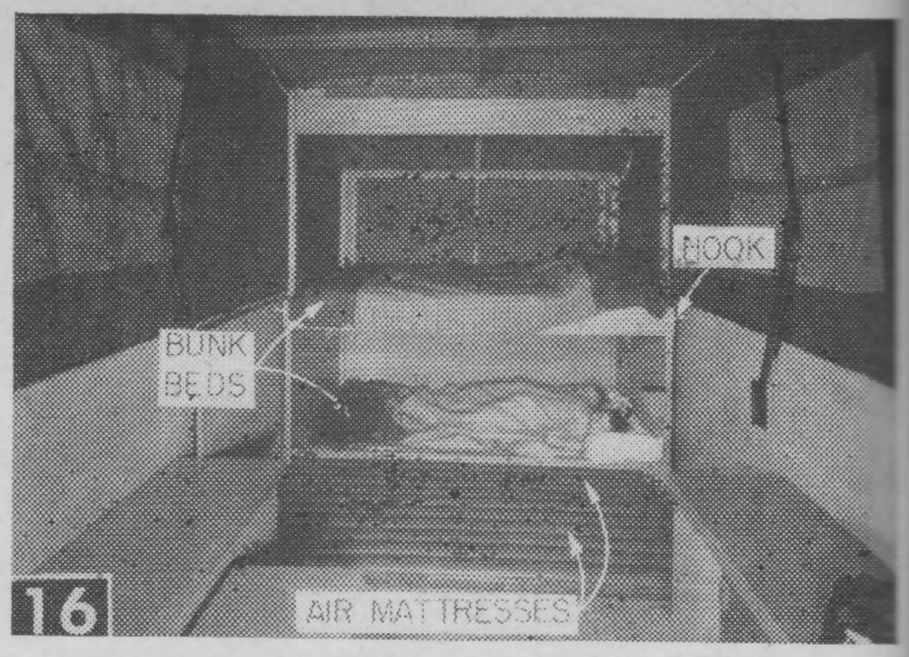


(Use #6 x ¾-in. *rh* screws spaced 6 in. apart along the outer edges, and ¾-in. nails spaced 4 in. apart along the butting edges of the hardboard. To make the seam weathertight, spread a thin layer of caulking compound about 3-in. wide along the seam and cover with a 2¾-in. wide strip of hardboard fastened in place with 4-40 x ½-in. *rh* machine screws as in sec. A-A, Fig. 14A.

To support the roof in the set-up position, install the cleats and hardboard guides on the rear panel as in sec. E-E, Fig. 14A and the front hinged roof support as in sec. D-D. The hardboard guide and ½-in. plywood backing on the rear panel cannot be over 18 in. long because it must fit into the top rear door opening when the rear panel is folded down for traveling. Top rear door must be left open when trailer is collapsed for traveling.

The Upper and Lower Panel Assemblies connecting the roof with the front edge of the bunk beds are designed so that the upper panel will cover the lower panel when in the collapsed position (Fig. 15A). Fasten the two panels together with four equally spaced hinges along their long sides (Fig. 15B). Then fasten the lower panel to the rail on the front of the bunk bed structure.

To hold the panel assemblies to the roof when it is to be set up for camping, fasten two sliding bolt locks to the top edge of the upper panel flush with the ends as in Fig. 15C. Drill holes into the roof stringers on the inside to take the sliding bolts, and reinforce



Two air mattresses on floor in front of the double bunk beds provide sleeping accommodations for six people. Hooks hold trailer sides to bunk beds.

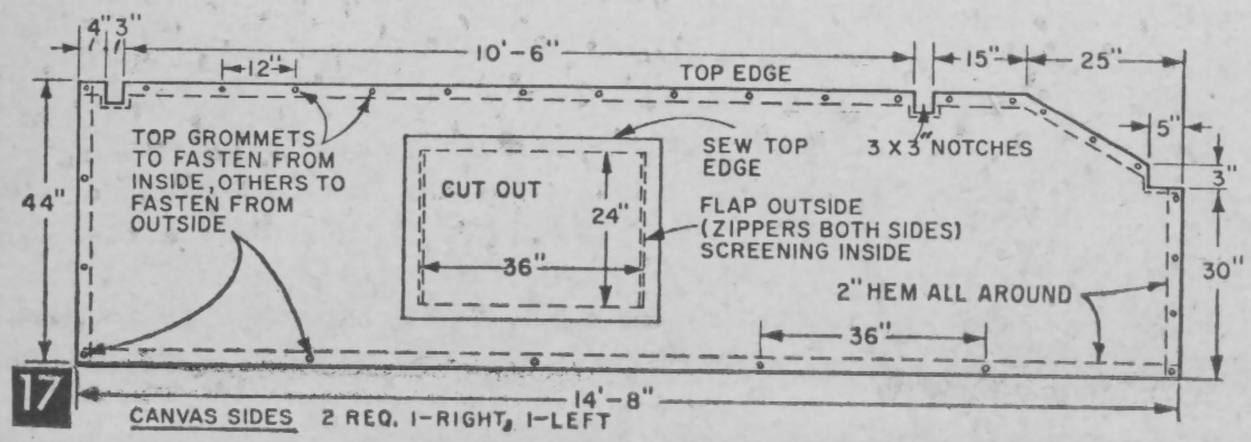
the holes with 16-gage steel plates. When the trailer is collapsed for traveling, disengage the sliding bolts and install 6-in. gate hooks as in Fig. 2, to hold the panels to the trailer sides. Apply 6-in. lengths of sponge rubber weatherstripping at all points where the panel assemblies contact one another in the folded position (including the hinged rear panel supports) to prevent rattles while traveling.

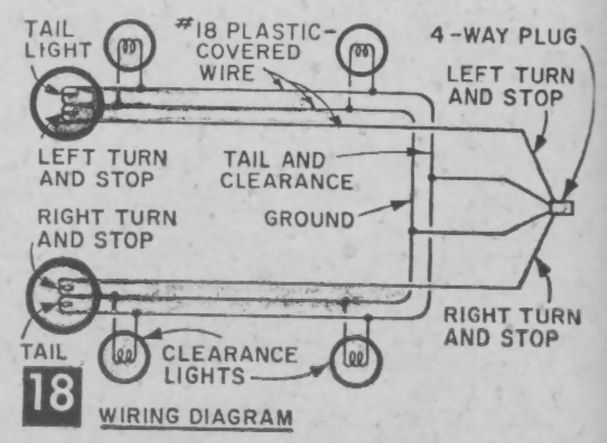
Now make the upper and lower doors (Fig. 11A and B) and hang them with 2-in. butt hinges recessed in the edges of the doors and rear panel framing. Install a night-latch type of lock on the bottom door.

Have your local awning shop make up the canvas sides for you according to the pattern given in Fig. 17. Be sure to tell the awning shop operator that the pattern dimensions are slightly oversize for shrinkage allowance. Before putting the sides up for the first time, moisten them with your garden hose and let them dry while fastened in place on the trailer. The sides should then shrink to the right size.

Note that the grommets for the *Dot* fasteners are installed so that the top of the canvas sides can be fastened from inside the trailer and the sides and bottom fastened from the outside of the trailer. Attach the *Dot* fasteners to the inside of the roof stringers as in sec. C-C, Fig. 14A, and to the bottom of the side rails as in Fig. 10.

To stiffen the trailer sides when the bunk beds are pulled out in the set-up position,





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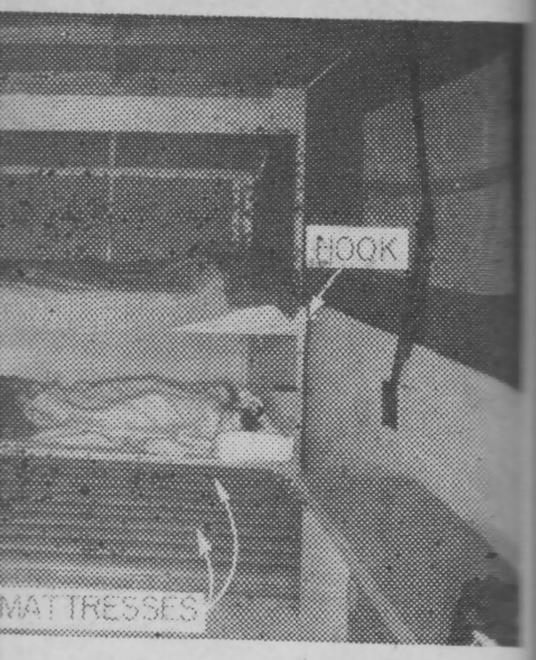

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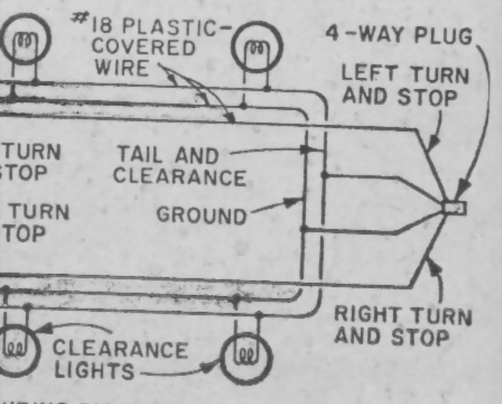

WIRING DIAGRAM

attach screen door hooks to the top corners of the bunk bed and locate the screw-eye so that the sides can be hooked to the bed as in Fig. 16. The auxiliary spring lifts, shown in Fig. 2, are optional. But they will assist in raising the roof and may be purchased ready made for $20 from Morrison Machine Shop, Lincolnway West, Morrison, Illinois. To aid in pulling out the bunk bed structure, make up the bracket for the roller skate wheels as in Fig. 12A and bolt it to the front of the bunk beds so that the skate wheels will roll on the trailer tongue.

Install the trailer turn signals, clearance and tail lights following the wiring diagram in Fig. 18. Use #18 plastic covered wire to hook up all lights and fasten the wires with insulated staples under the side rails and down the outside of the side panel and then along the side of the tongue to the 4-way switch. Drill a hole in your car trunk as near to the hitch as possible to take the wires leading from the other end of the 4-way connector. Connect these wires to the existing wires in the trunk of your car.

Since the weight on the trailer tongue is low, you will not require a trailer hitch having a built-in jack. Merely make a tongue support as in Fig. 2 from scrap 2 x 6-in. stock. For the rear make a tapered rear support as in Fig. 2 which can be pushed under the trailer floor assembly to hold the trailer level when it is parked for camping. Because the height of these supports will vary depending upon the wheels and tires you use, determine the heights of the supports by measuring the ground-to-trailer distance.

For a finish, apply one coat of Firzite, one coat of enamel undercoater and one coat of exterior enamel in your choice of color. With the exception of fastening four draw-bolt type cabinet catches to hold the roof down as in Fig. 14B, your trailer is complete and ready to hit the road on that long awaited camping trip. Remember to inflate trailer tires to only 10-12-lbs. to offset lack of springs and provide proper cushioning.

• Craft Prints in enlarged size for building house trailers are available at $2 each. Order by print number. To avoid possible loss of coin or currency in the mails, we suggest you remit by check or money order. (No C.O.D.'s or stamps.) Now available, our new illustrated catalog of "196 Do It Yourself Plans," 10¢, SCIENCE AND MECHANICS, 450 East Ohio Street, Chicago 11, Illinois. Please allow three to four weeks for delivery.

Tree Planting Hint

• When planting a tree, face the poorer side toward the southeast so it will receive more morning light. Since morning light is up to 20% more intense than afternoon light, the poorer side of the tree will have developed within a few years as well as the other parts.

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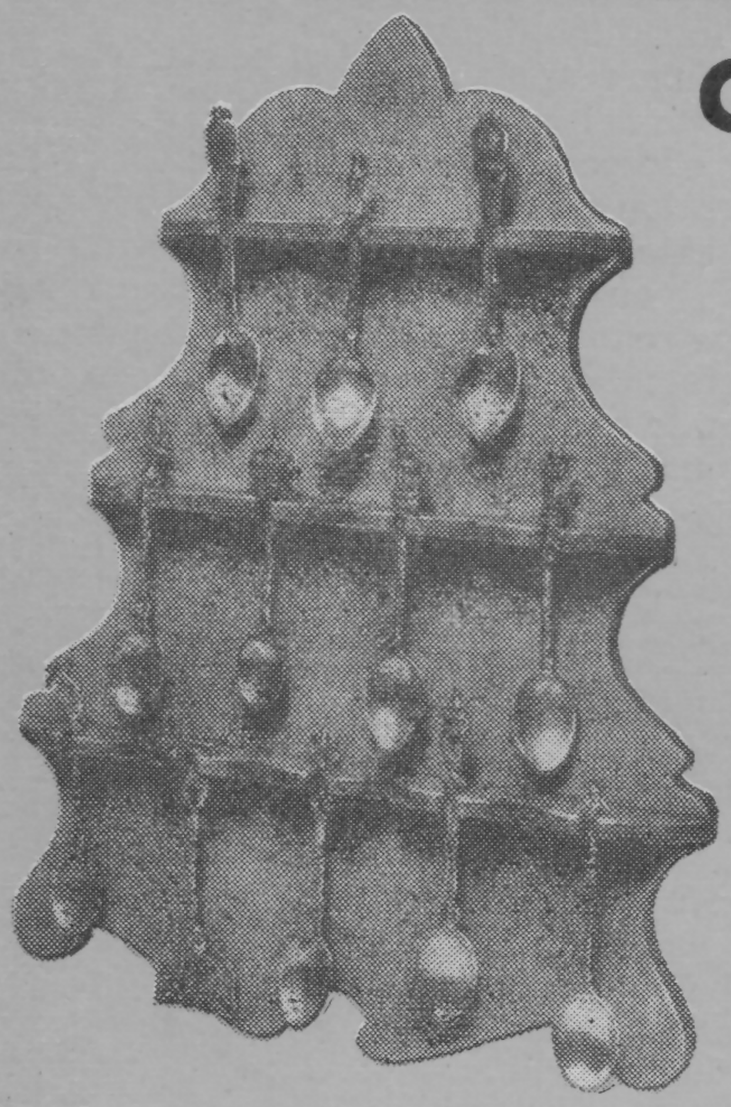
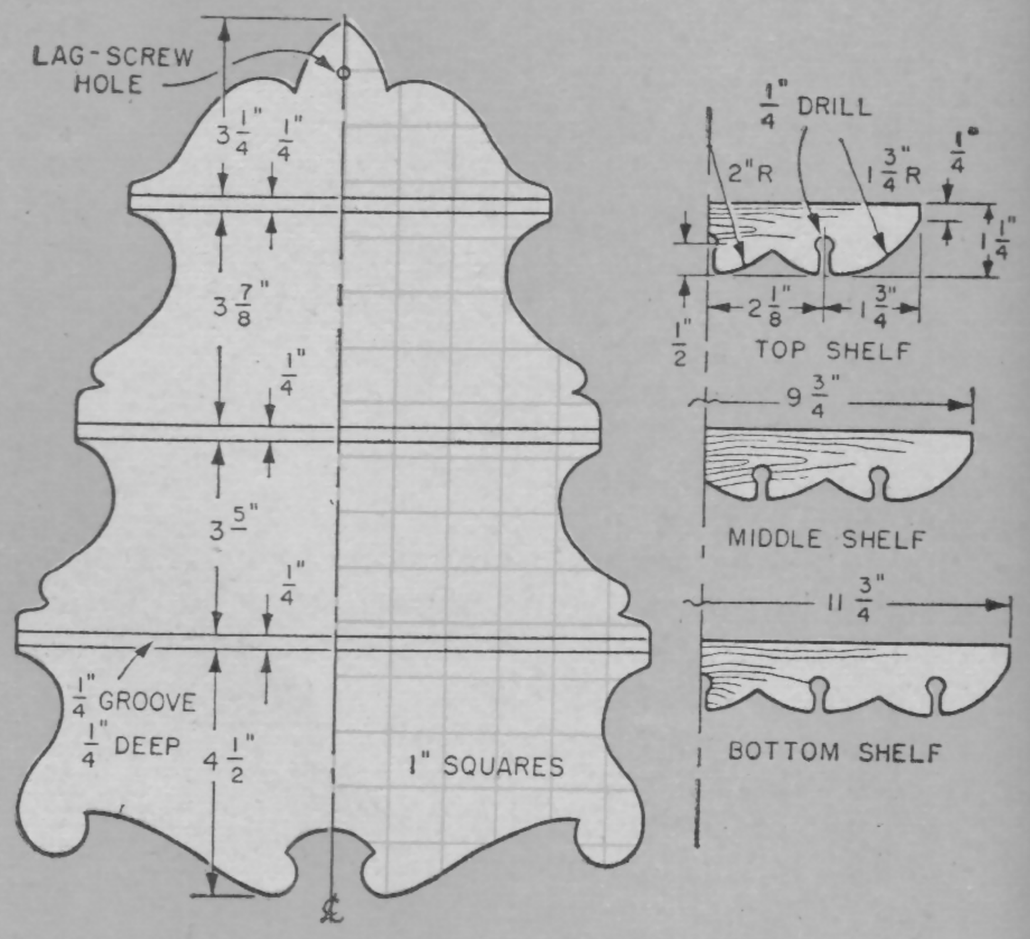
One-Evening Projects

Colonial Spoon Rack





THIS craftsman's "quickie" is a guaranteed wife delighter.

First cut the three required grooves or dadoes in a ½ x 11¾ x 16-in. background piece of clear white pine. Then bandsaw out the squared pattern profile.

Although the three shelves vary in size and number of holes drilled they are all the same otherwise. Leave a ¼-in. straight-edge on each end of each shelf, where the shelf will fit into the groove. Then mark out scallops and drill ¼-in. holes as indicated, each centered ½-in. from outside edge. Saw a ⅛-in. channel from outer edge into drilled hole, rounding corners with either saw or file.

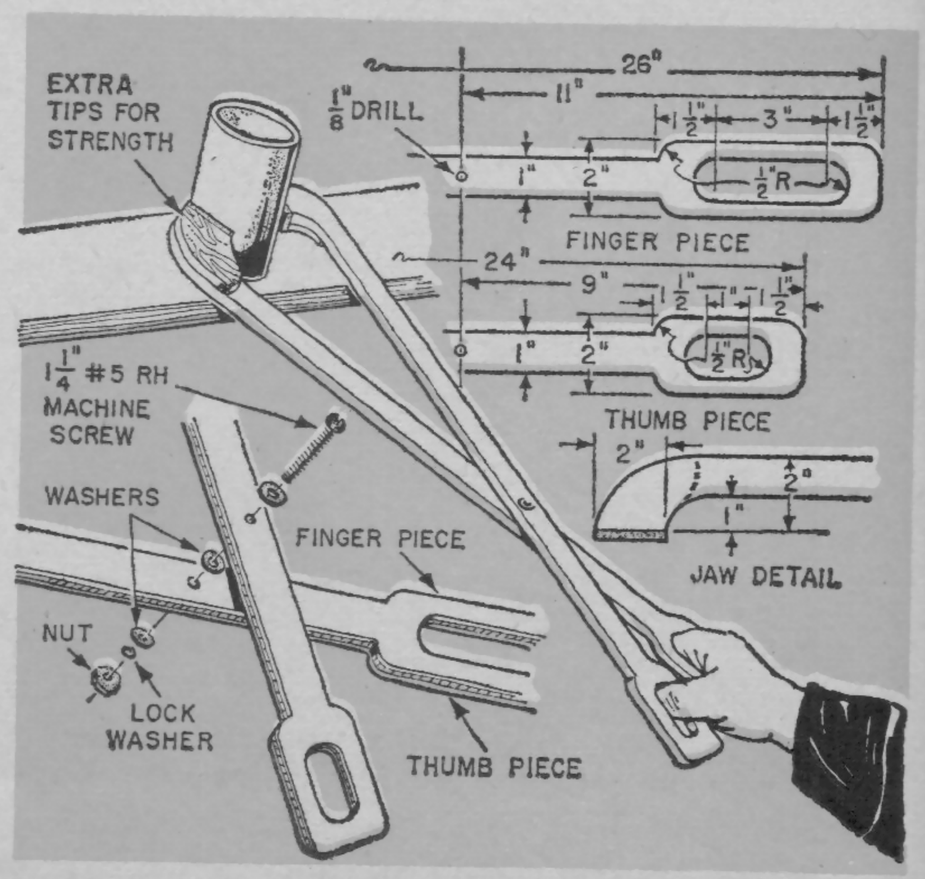
Glue shelves into grooves. Then sand carefully and apply stain and two coats of varnish, lightly sanded between coats. Rub boiled linseed oil and pumice onto the final coat, wipe clean and let dry 48 hours. Then apply second coat of oil, always rubbing with the grain.

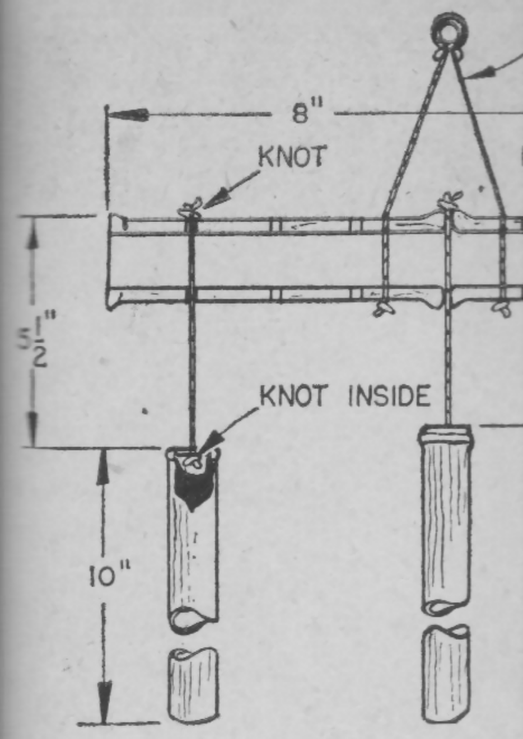
Attach rack to wall with a ¼-in. lag screw and insert a dozen decorative silver spoons in the shelf holes.—N.E.

Handy Grabbers

WHY keep climbing up on a stool to reach those high shelves, when you can make a pair of strong, lightweight grabbers in just a few minutes? They also put a very useful stretch into the reach of bed-bound convalescent patients.

Cut the grabbers out of ⅜-in. plywood as illustrated here. Glue on extra tips for both strength and double grip-ability, as well as to prevent what the dentists call *malocclusion,* that is, the jaws not meeting right. Cement a thin strip of foam rubber to the jaws to prevent slippage. Join the two pieces together with bolt and washers as in Fig. 2, and finish as desired.—ANTHONY EDWARDS.





HERE'S how to turn a pole into breeze-blow

Starting at the butt e cut off the 8-in. long Then cut the seven "chimes." Each should b and cut just above the k that the top end will be tom open. Drill seven 1 1-in. apart through the Then drill a 1/16-in. hole end of each hanging piec

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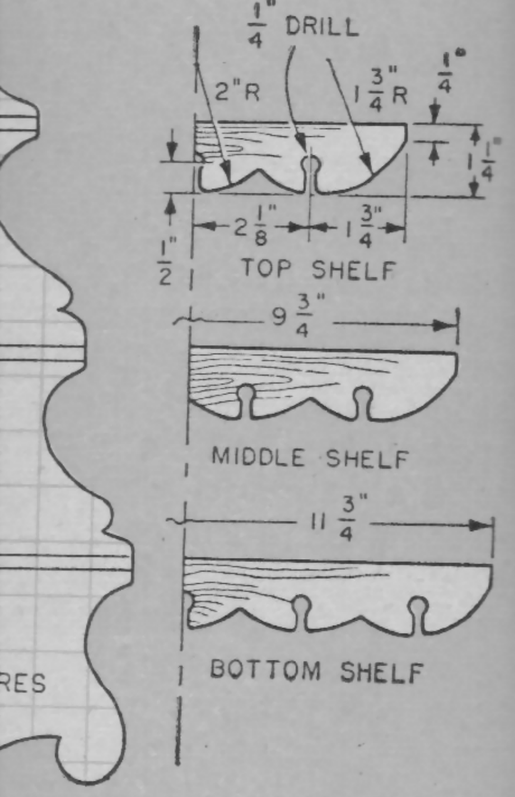

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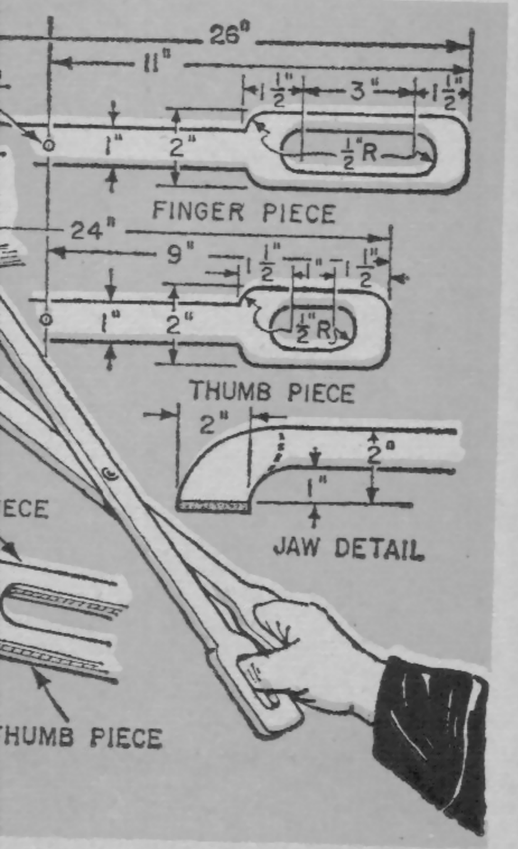
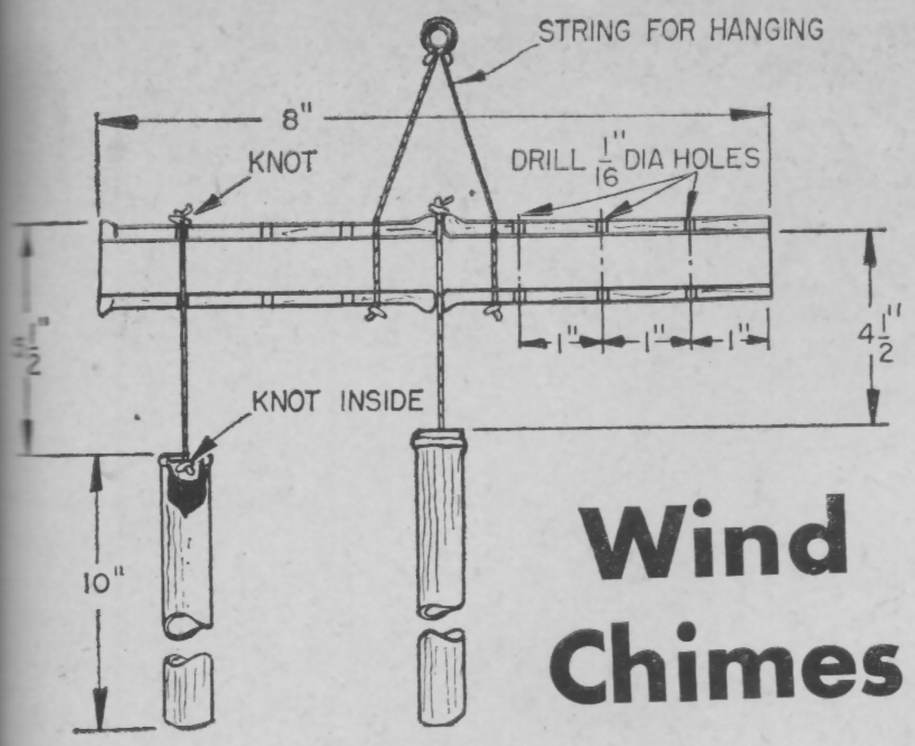


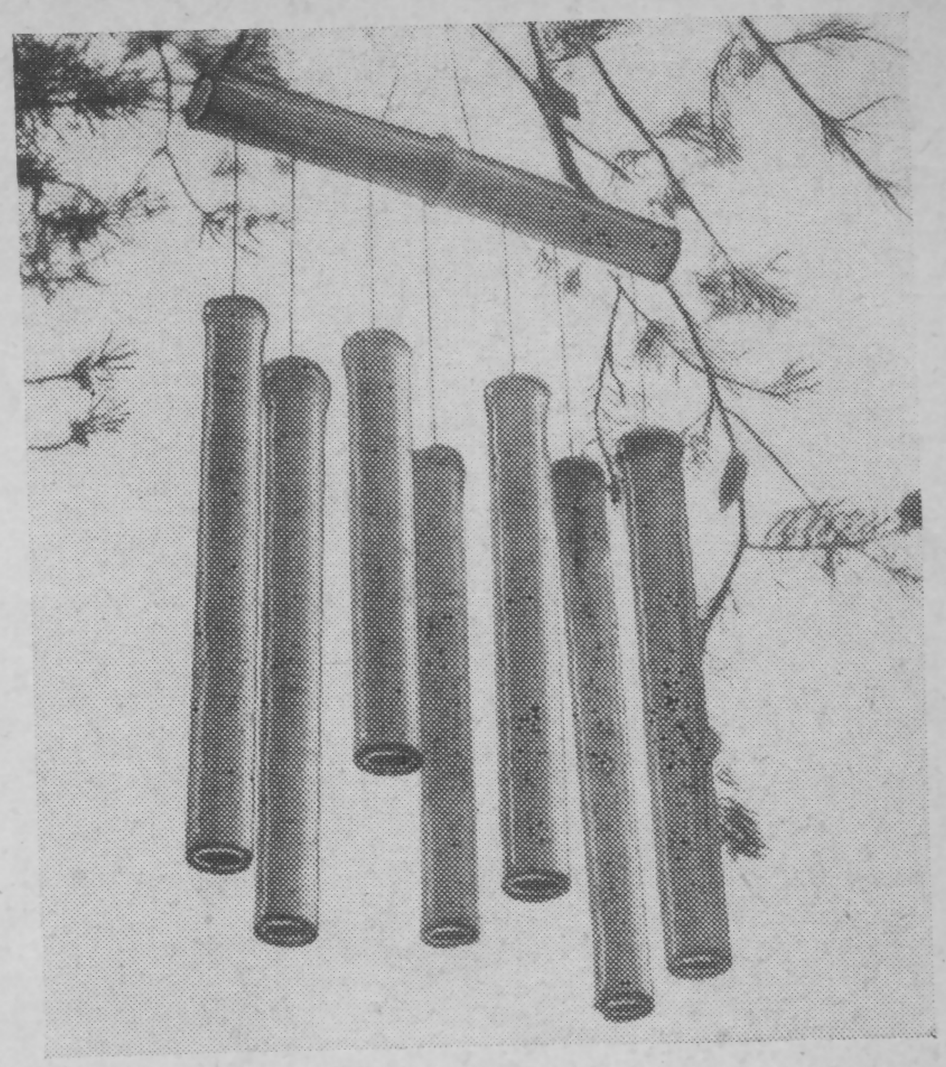


Wind Chimes

HERE'S how to turn an old bamboo fish pole into breeze-blown music.

Starting at the butt end of the fish pole, cut off the 8-in. long horizontal segment. Then cut the seven hanging pieces or "chimes." Each should be about 10-in. long and cut just above the knuckle, or joint, so that the top end will be closed and the bottom open. Drill seven 1/16-in. holes spaced 1-in. apart through the horizontal piece. Then drill a 1/16-in. hole through the closed end of each hanging piece.

Using a darning needle, thread a length of nylon fish line through the first hole in the horizontal piece, then through the closed end of the hanging piece. Let the string come through the open end of the hanging piece and tie a heavy knot at the end. Then pull the string back so the knot draws up snugly



to the hole.

Now tie another knot so the hanging piece will dangle about 4½-5½-in. below the horizontal section. String up the other pieces the same way, alternating lengths and diameters. The larger the diameter, the lower the pitch of its note. If you want higher notes, you can cut each hanging chime off shorter.

Hung up next to a set of commercial glass or metal wind bells your weatherproof bamboo chimes will provide a fine orchestral contrast of resounding base *clinks* to the higher *tinkles*.—JOHN ENGELS.

Colander Lamp Shade

Make a dime store tin strainer or colander into an attractive, informal lamp shade.

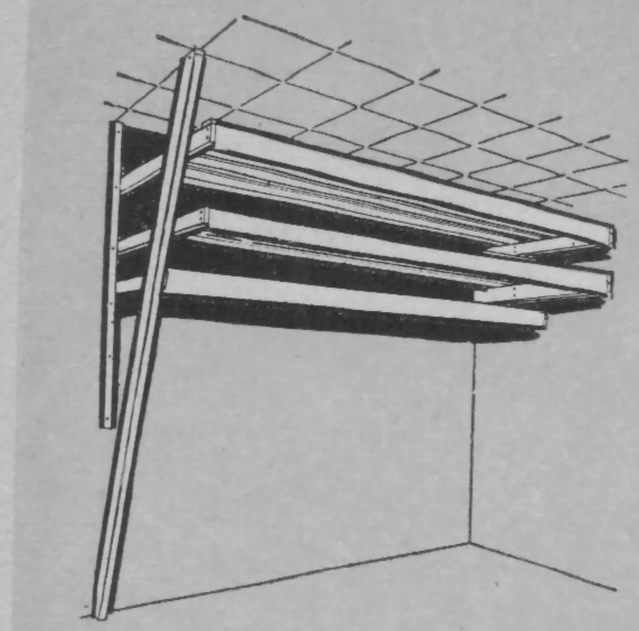
With a grease pencil, center a 1¼-in. hole in colander bottom, and cut out with curved tin snips. File edges smooth.

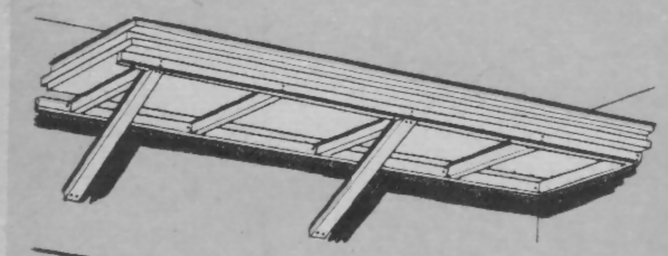
If you wish to paint the shade, first apply red sanding primer over shade. After 24 hours, rub lightly with 000 steel wool and coat outside with flat paint.

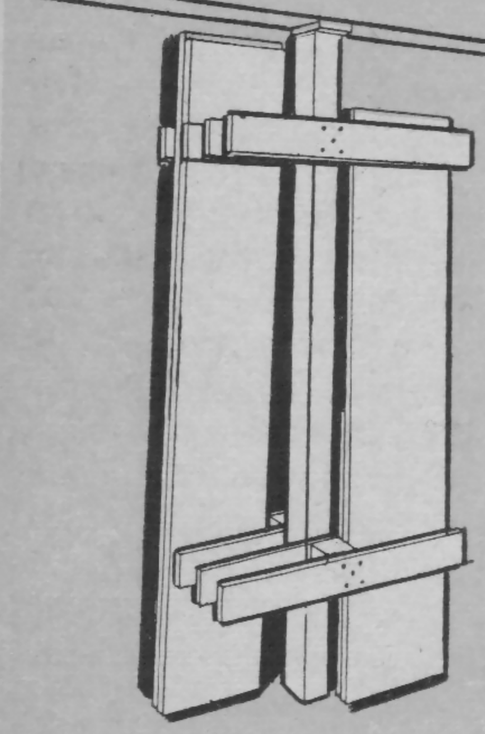
To obtain the effect of a brass lining, thinly cover inside of shade with clear varnish. Let stand until your finger will glide over surface, but you can make a faint print by pressing down. Now place a ½-teaspoonful of brass powder (*Brush Brass Lining* from art supply or paint shops) in a jar lid. Wrap a bit of soft cotton cloth around your finger; dip in powder, then rub lightly over the varnished tin. Repeat until entire inside surface

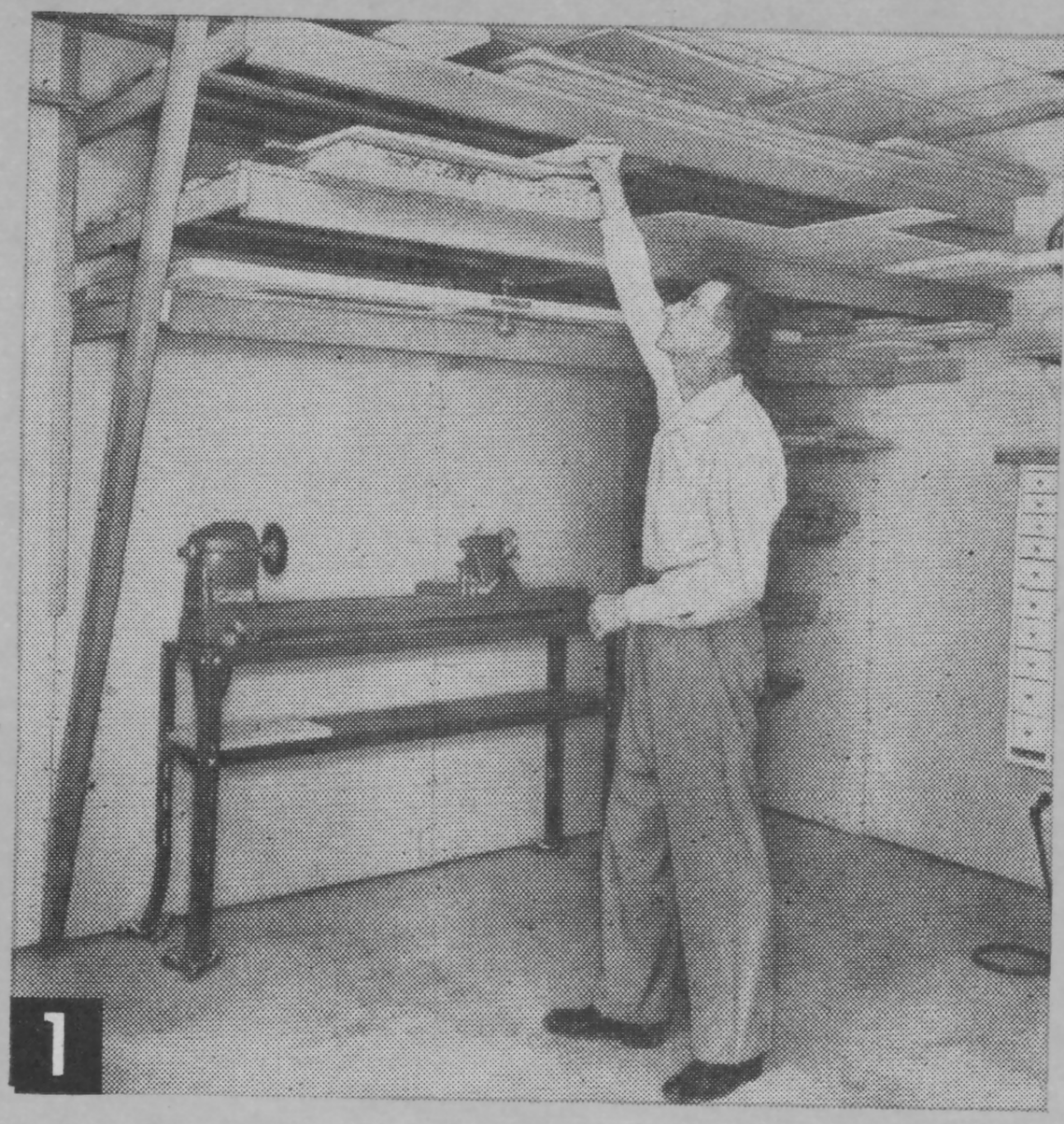
is bronzed. When dry, brush off excess powder. Apply a second coat of varnish.

To mount shade, use the pin-up lamp type shade holder that slips over the bulb. Snap the other end of the holder into the hole in the shade. To use the shade as a reflector type, apply electrical tape around the hole, slip the bulb through the hole and screw into the light socket.—E. ENGELS.





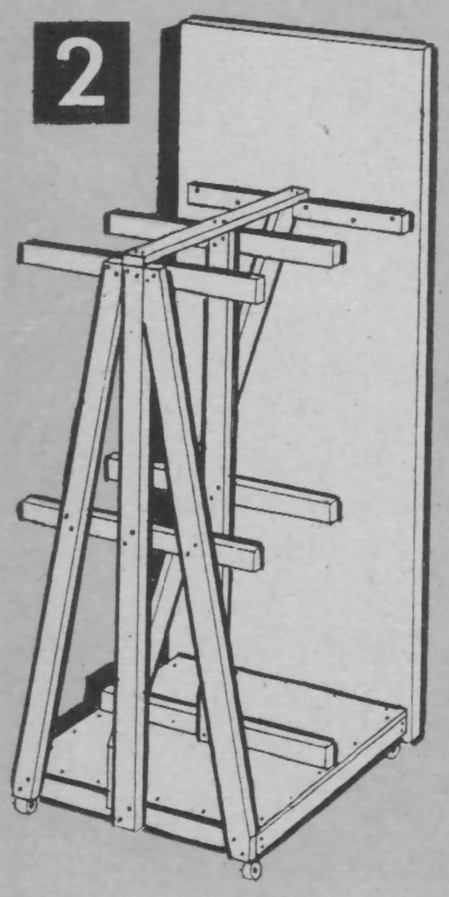




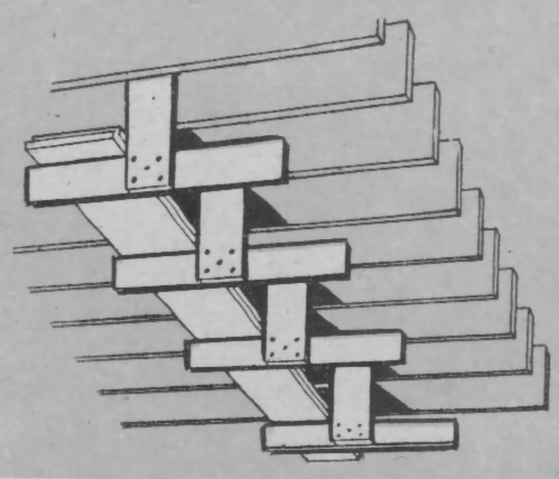
How A "Shop Pro" Stores His Lumber

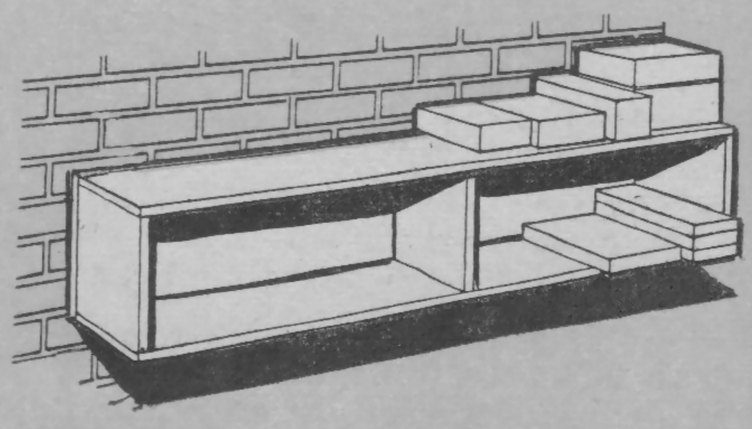
Editor's Note: Problems call for experts whose training and experience have taught them the best solutions. That's why we asked Edwin Love—a long-time expert on workshop techniques—to dig deep into his lumber-handling lore, and come up with this special advice for you. Although Ed would be modest enough to object to our calling him a "pro", what he says is worthy reading.

By EDWIN M. LOVE



THERE'S a knack to storing workshop boards and plywood. First, you must find storage room—within handy reach—in a workshop usually crowded with tools (and projects the wife is waiting for you to fix). Second, the lumber must be stored so that it is not dam-



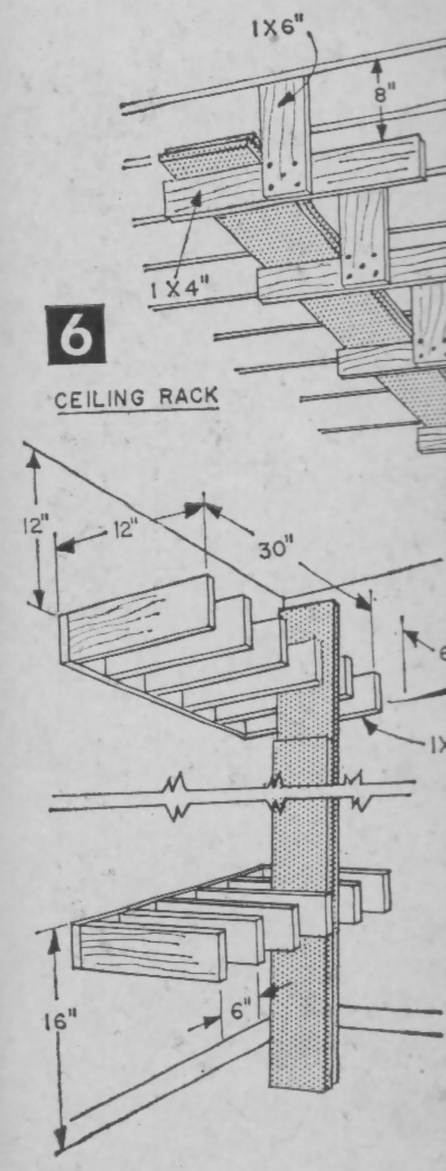


aged by moisture and heat.

The nine suggestions given here (Fig. 2) have worked well for me, and they should help you with the problem of finding space where none appears to be. As a general rule, it is best to store lumber horizontally, so that the weight of the boards helps to hold them flat. Vertical storage of the boards subjects lower and upper ends to differing climates, and some warping strain from weight, but limited space may make it necessary. Vertical racks are convenient.

Boards should not concrete floor, where tion might upset the m wood. Nor should they heated air under a hot checking. Fortunately your lumber above th shops are not too hot

Lumber racks can rectly to frame walls b studs. In masonry, eith plugs driven into hol with a star drill, or u



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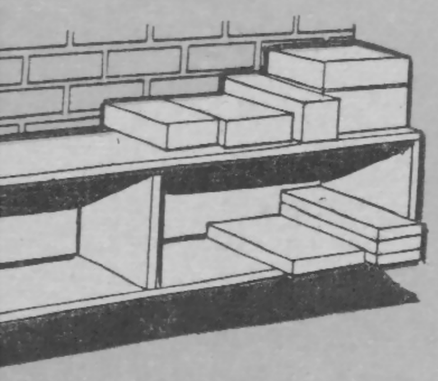

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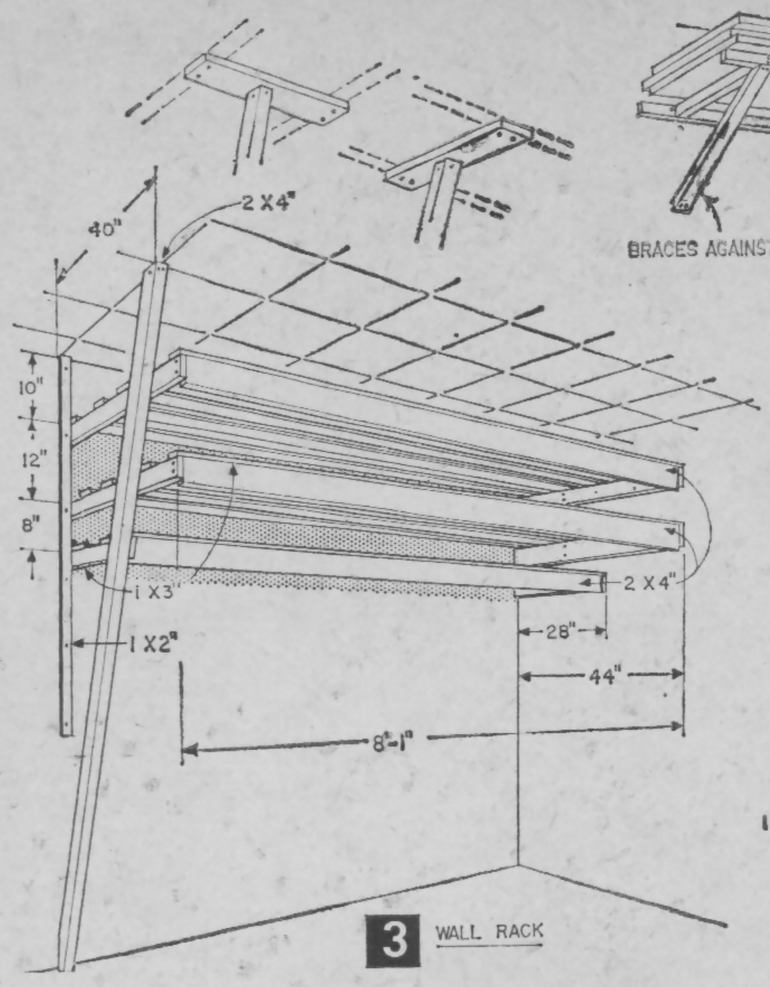
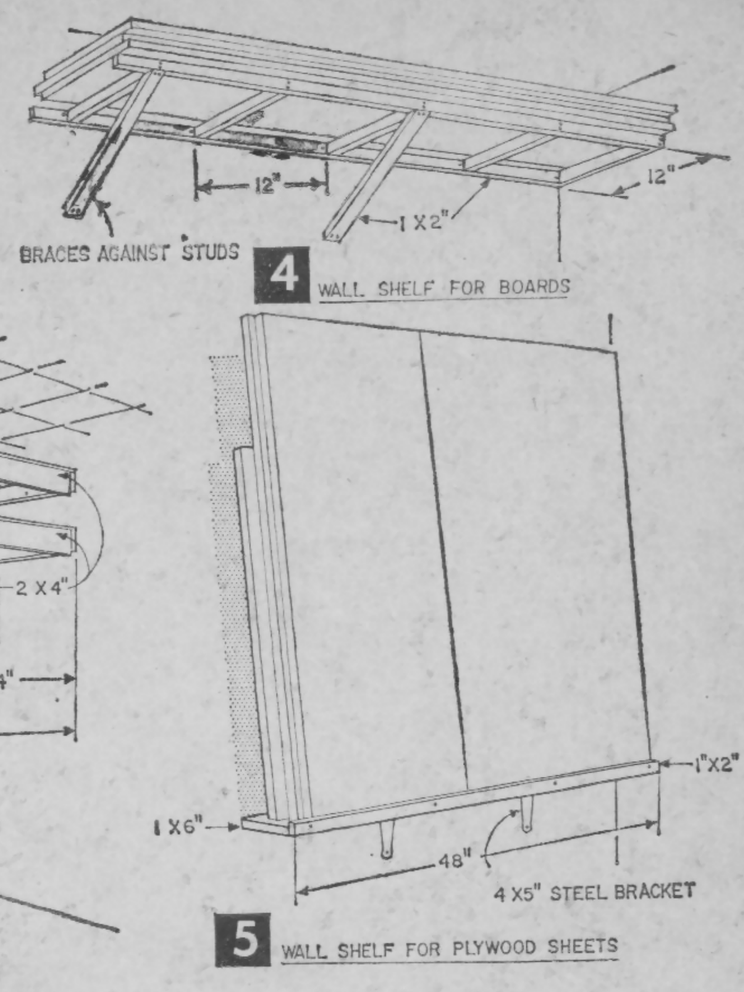
Boards should not be laid directly on a concrete floor, where seepage or condensation might upset the moisture balance of the wood. Nor should they be stored in the superheated air under a hot roof, which may cause checking. Fortunately, it is not hard to rack your lumber above the floor, and most home shops are not too hot and dry at the ceiling.

Lumber racks can usually be spiked directly to frame walls by driving nails into the studs. In masonry, either nail them into wood plugs driven into holes made in the mortar with a star drill, or use masonry anchors.



3 WALL RACK

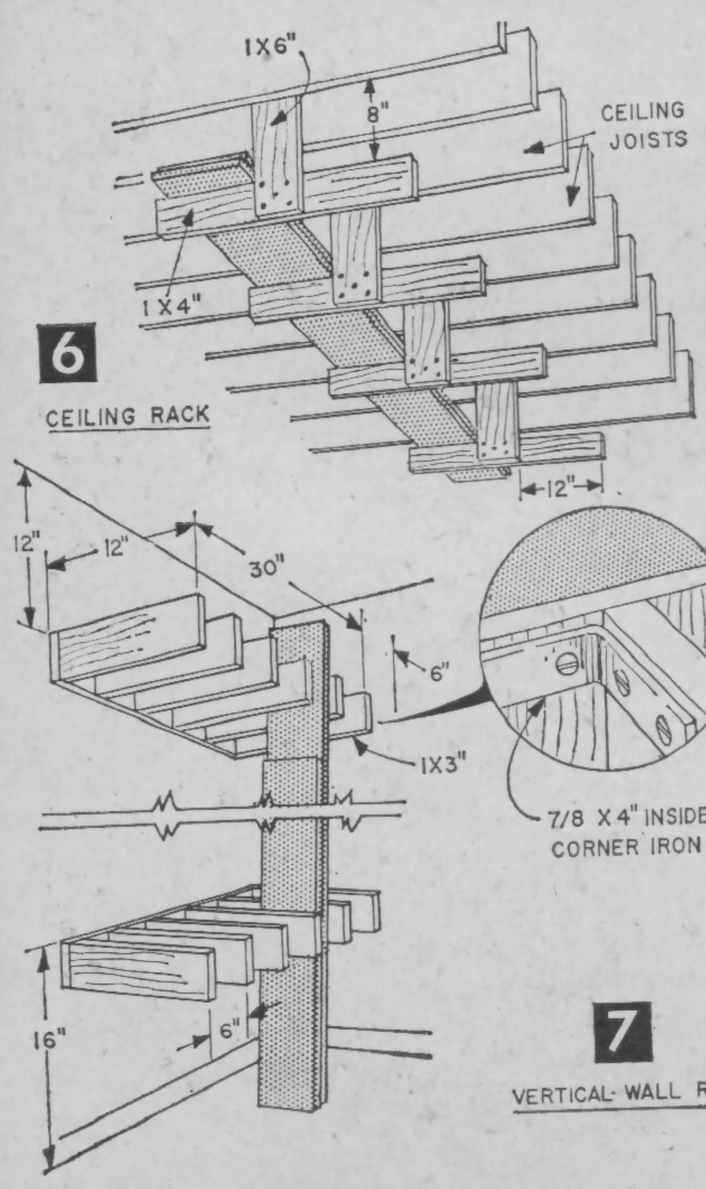


4 WALL SHELF FOR BOARDS

5 WALL SHELF FOR PLYWOOD SHEETS

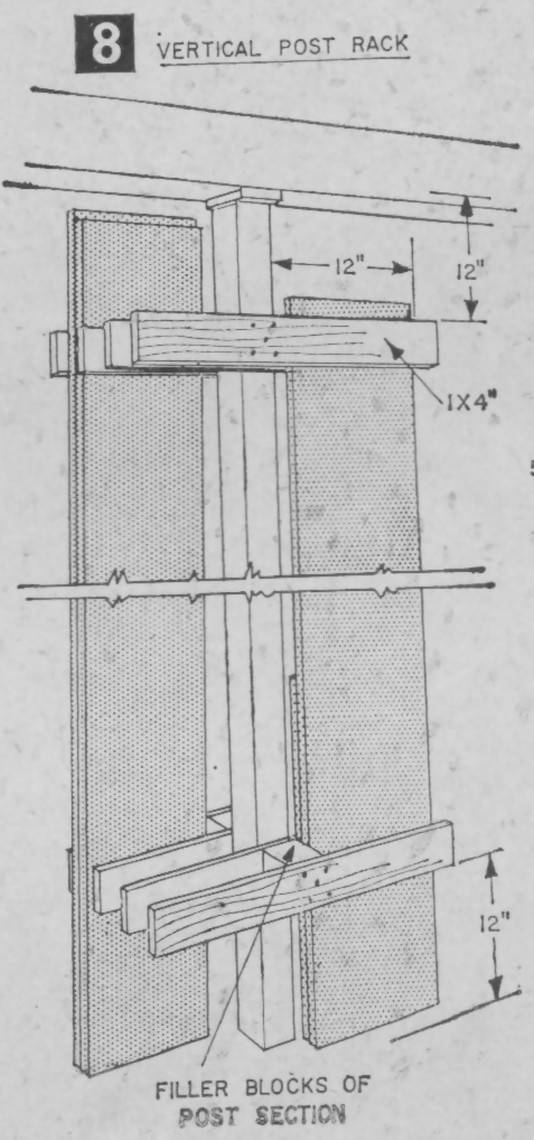
The rack shown in Figs. 1 and 3 affords handy flat storage, where materials can be slid in or out from the front. Being located above the height center of the wall, the shelves leave the wall free for a bench or a machine. To accommodate a full plywood sheet the inside length is a little more than 8 ft. You can nail the foot of the sloping support anywhere along the sole plate, but if the upper end cannot be spiked to a ceiling joist, use a cleat bridging two joists.

Nail up a vertical wall cleat to carry the shelf supports, or rest them on cleats span-

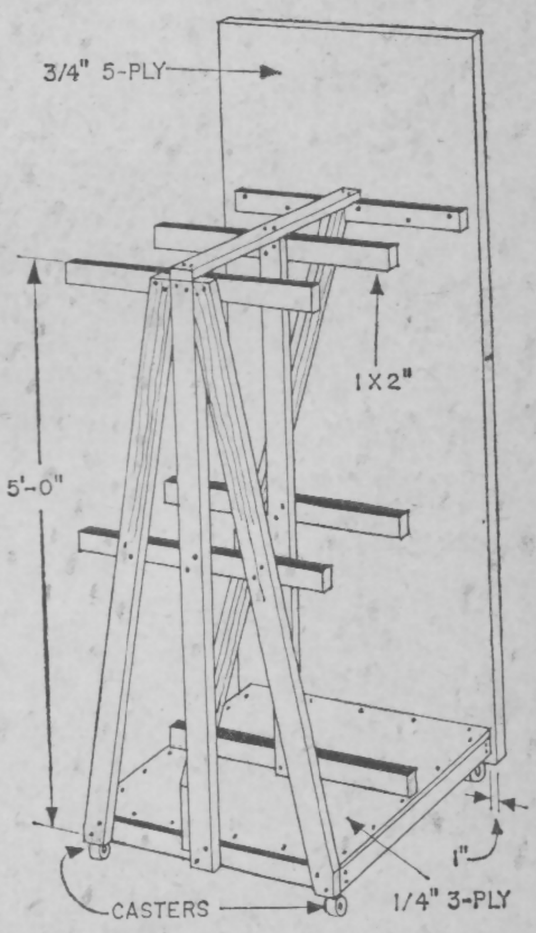


6 CEILING RACK

7 VERTICAL WALL RACK



8 VERTICAL POST RACK



9 CLOSET RACK

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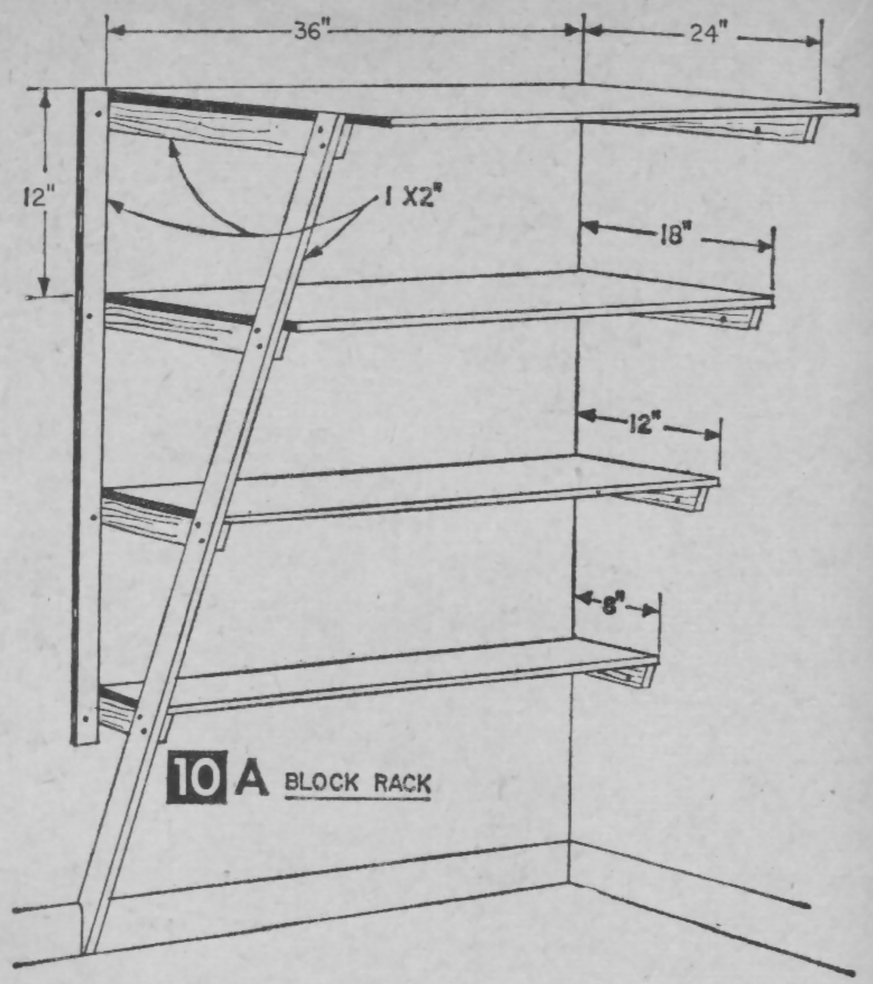
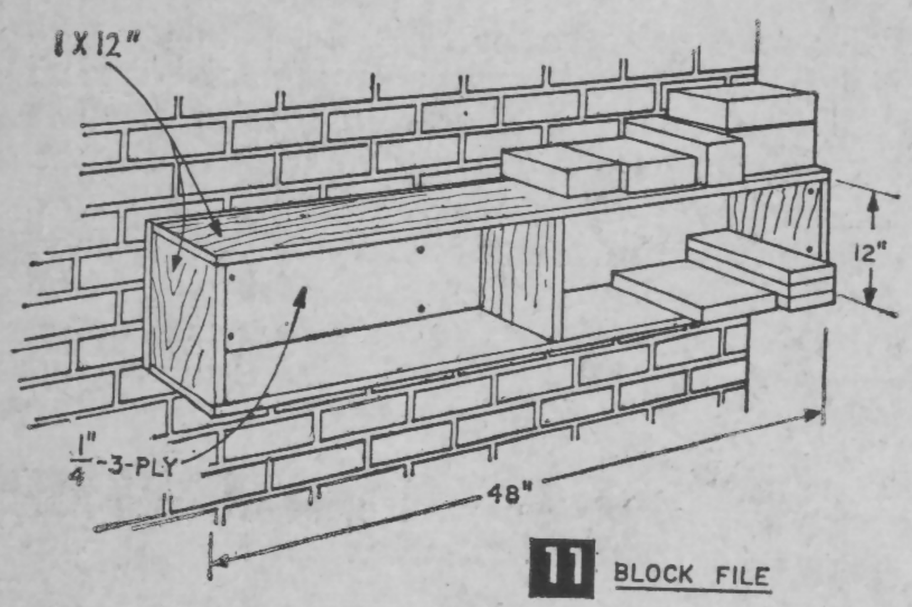




11 BLOCK FILE

ning the studs. Strip the shelves with 1 x 3-in. fir.

A single, ladder-like shelf (Fig. 4) built from 1 x 2-in. strips mounted on a wall near the ceiling is one of the most convenient of lumber racks. As this space is likely to be free, the shelf can be extended for some distance for storing long boards. Or it can be used sectionally, with boards of one width piled together.

For storage of half-sheets of plywood or smaller, try a narrow-ledged shelf located on an upper half of a wall, as in Fig. 5. Steel brackets, having no braces, conserve space by allowing a machine to fit snugly under the shelf. The nearly upright position of the plywood nullifies side stresses, helps the plywood to retain its flatness.

Where there's no wall space for a horizontal rack, try hanging a double-rack from the ceiling joists, as in Fig. 6. Nail the hangers to the joist sides, and then the cross-pieces to the hangers, thus providing for boards to be laid on from both sides. On covered ceilings, attach the hangers to the ceiling with iron inside corners. Avoid heavy loading of such a rack.

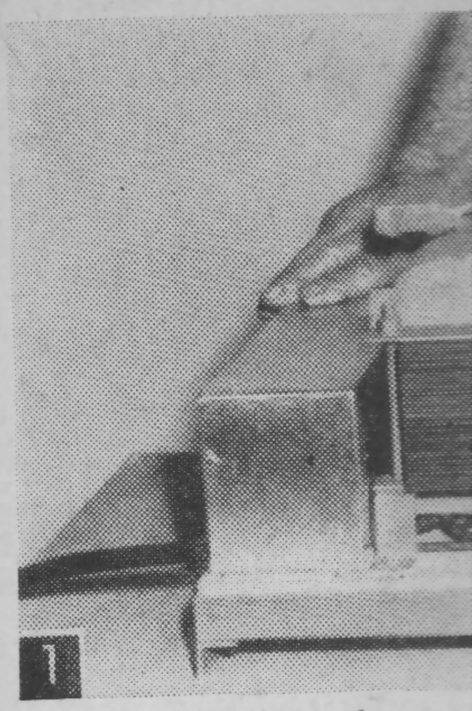
When horizontal racks are not possible, find a corner for vertical lumber storage as in Fig. 7. Two sets of spacers or fingers built of 1 x 3-in. stock support a few boards in each pocket; an added center set will take care of short boards. Iron inside corners hold the spacers rigidly, if placed near the upper edges and secured with stove bolts having washers and nuts sunk flush in counterbores. Attach the backs of the racks to the wall with lag screws or substantial masonry anchors.

If your shop has columns supporting a girder these may be converted into vertical storage racks as in Fig. 8, using spacer blocks cut from beams of the same size as the posts.

Basement shops occasionally have closets opening from them, and these offer space for vertical racks on wheels (Fig. 9). Build a base frame of 1 x 3-in. strips 2 in. narrower than the opening. Brace in both directions. Such a rack not only rolls out easily for access, but can be moved to the point of use. Attach plate casters with 1¼-in. wheels to corner blocks set under the platform.

But what about short boards and blocks? Tossed in a box, these become hard to sort. Why not have a short 3-decker rack, as in Fig. 10, which gives you a visible file system. Such a low corner rack is partially visible in Fig. 1. Range the pieces from small to large and according to thickness and width, with lengths appropriate to the shelves. Stack woods of a kind together, ends out. With this setup, loose blocks are easily stored.

Another idea for a small block file is shown in Fig. 11. This rack is made of 12-in. boards having a plywood back. It is attached to a wall with nails or anchor screws driven through the back. Adapt the length to your available space and locate it conveniently.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Spot welding two sheet ste

SHOP

Spot W

By HAROLD
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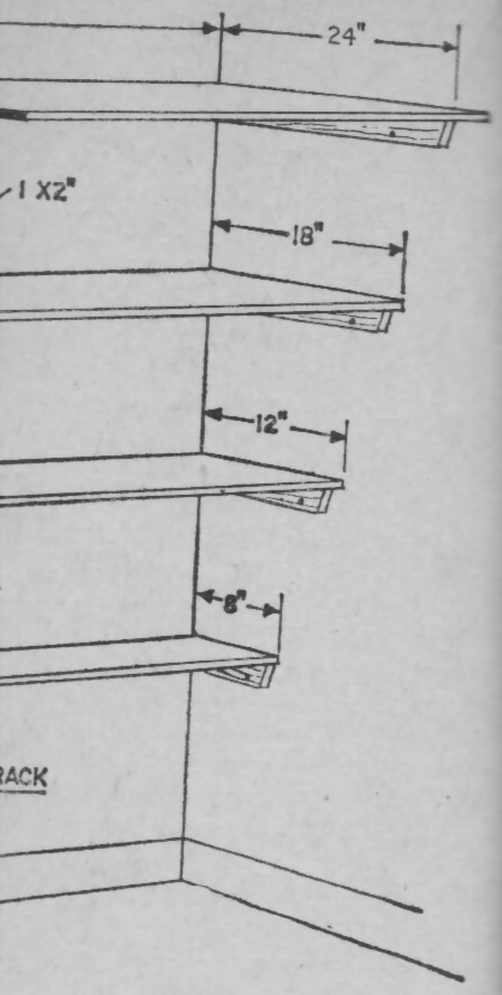

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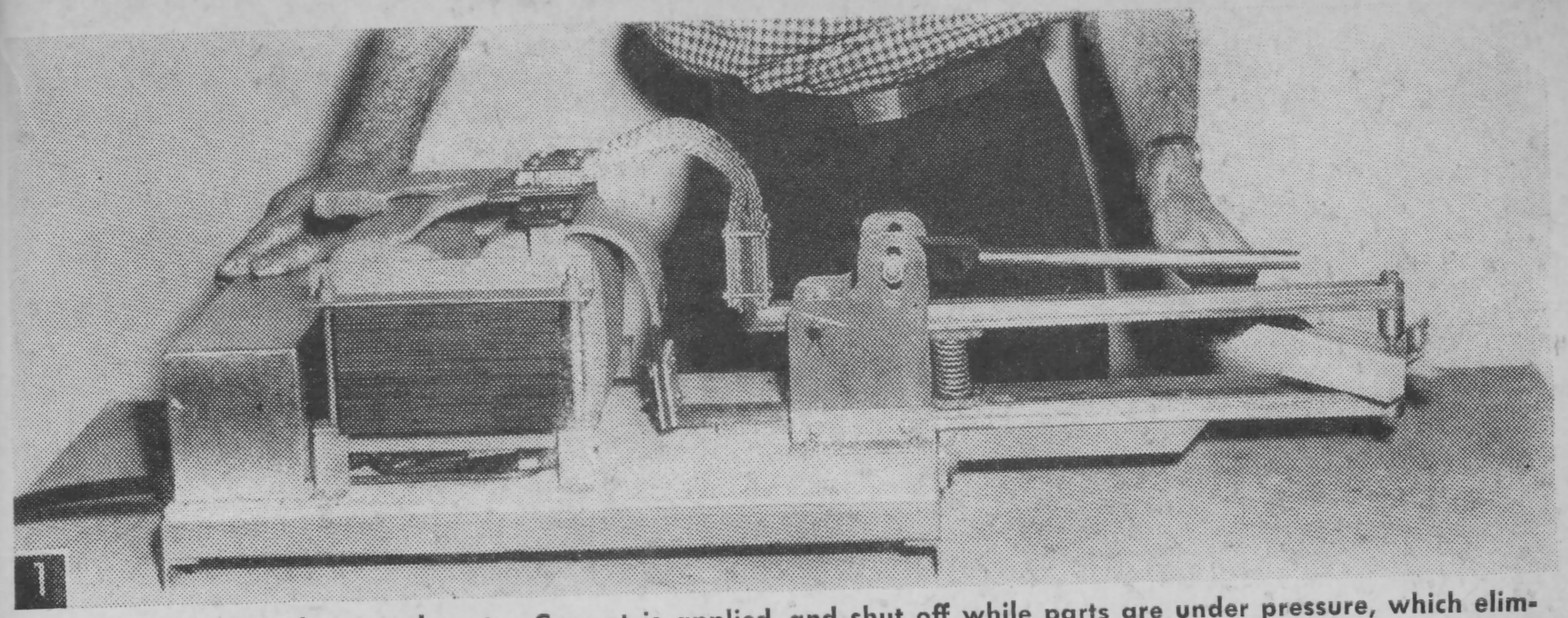


1 Spot welding two sheet steel parts. Current is applied and shut off while parts are under pressure, which eliminates burning of metal and results in clean welds.

SHOP BENCH

Spot Welder

By HAROLD P. STRAND
Electrical Editor

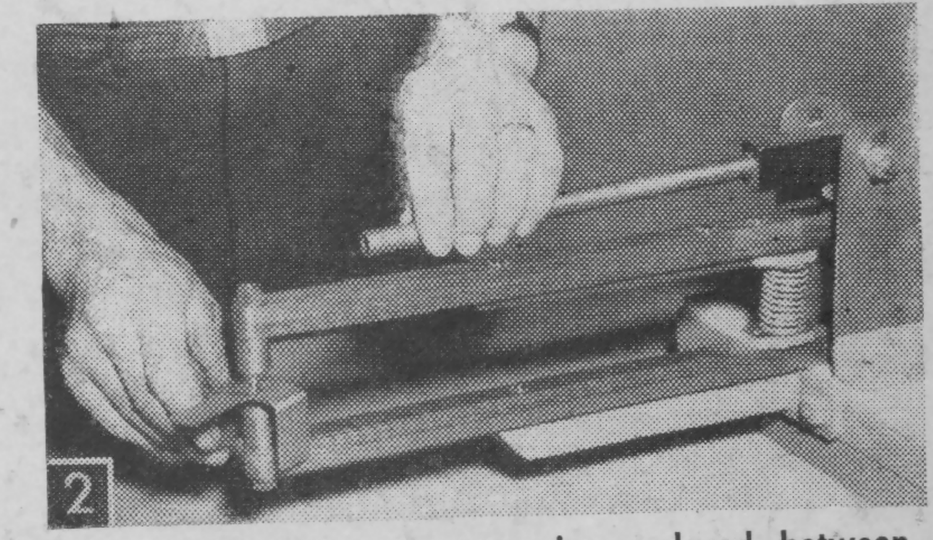
Part 1

A SMALL spot welder makes a quick, permanent bond without rivets or bolts —saving the metalworker considerable time and work.

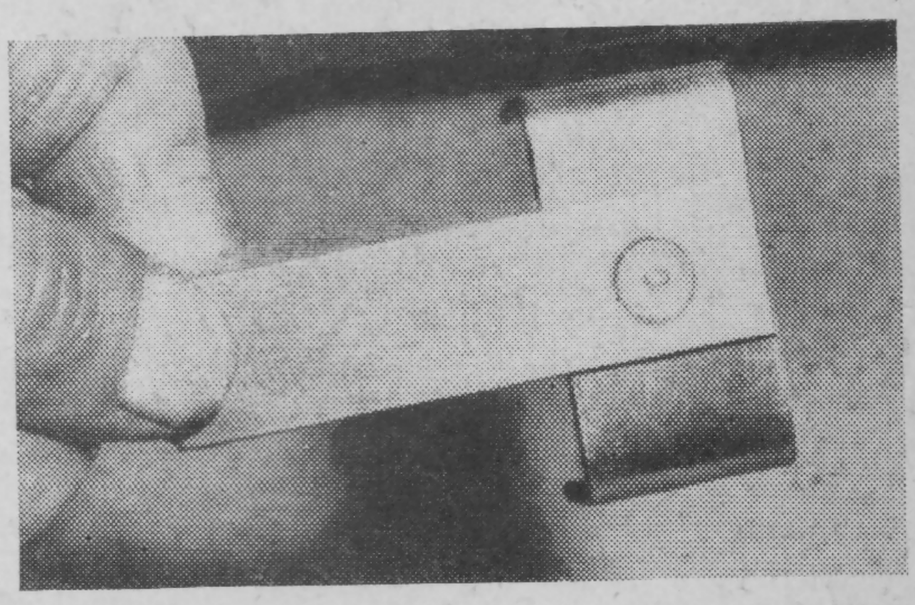
This welder, small enough to be portable, will join together sheet steel and parts up to about 3/32-in. thick. It will operate on 115 volts, 60 cycles, through an outlet wired with #10 wire and fused 30 amperes. Contact with the line is but momentary—a few seconds at the most—so we found that a 30-ampere fuse would hold. You can also provide connections for 230 volts, which draw less line current, by using the additional primary turns mentioned later plus a 230-volt relay and a push switch in place of the 115-volt equipment shown.

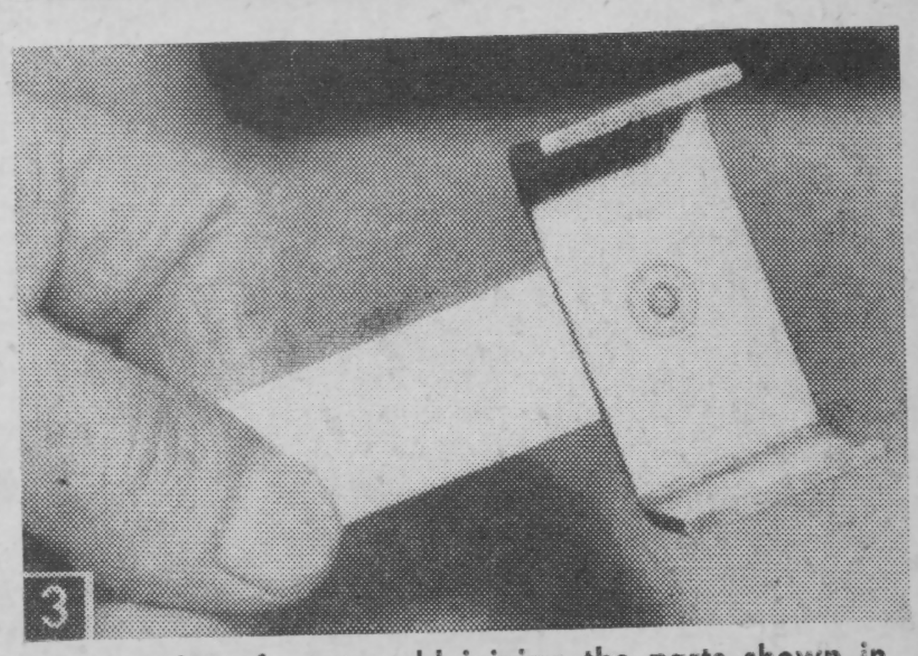
To spot weld, you must pass a very high current at low voltage through the parts to be joined, let's say 1,500 to 2,000 amperes at 3 volts. This high current produces white heat almost instantly in a small circle on work which is pressure-clamped between two copper electrodes (Fig. 2). When the heating occurs, the metal melts and the pressure forces it together to make a permanently fused joint (Figs. 3 and 4).

The transformer must be of heavy construction with large conductors capable of



2 Applying pressure to two pieces placed between electrodes, prior to welding. Fig. 3 shows results of weld.

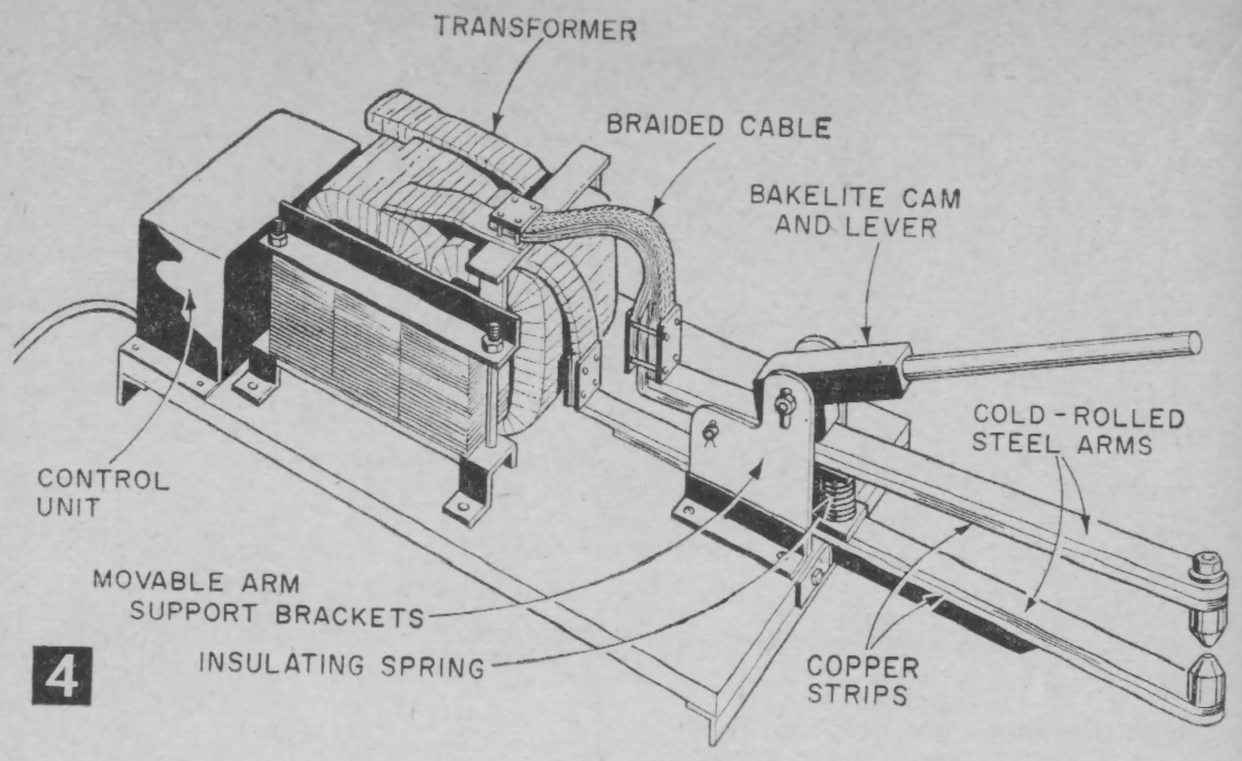




3 Both sides of neat weld joining the parts shown in Fig. 2.

carrying the high current. The secondary winding, which furnishes the welding current, consists of nine strips of flat sheet copper, laid together and taped. The primary consists of #12 Formvar magnet wire. In order to keep flux leakage to a minimum and thus provide as efficient a transformer as possible, the winding is done on two coils (half the winding on each) which are joined together in series. This design provides the necessary voltage regulation, since the welding method is virtually a short-circuit on the transformer, except for the small resistance represented by the steel pieces between the electrodes.

Don't attempt to weld brass, aluminum or other low resistance metals on this unit; it is strictly a welder for all kinds of steel up to 3/32-in. capacity in thickness. I have actually welded material up to ⅛-in. thickness (two pieces of ⅛ in. placed together) with it, but it is a little beyond the capacity of this small unit and you may blow the fuse. For thin material, you need only a momentary contact, but use up to two or three seconds for heavier stock. Never keep the current applied over four or five seconds at the most.



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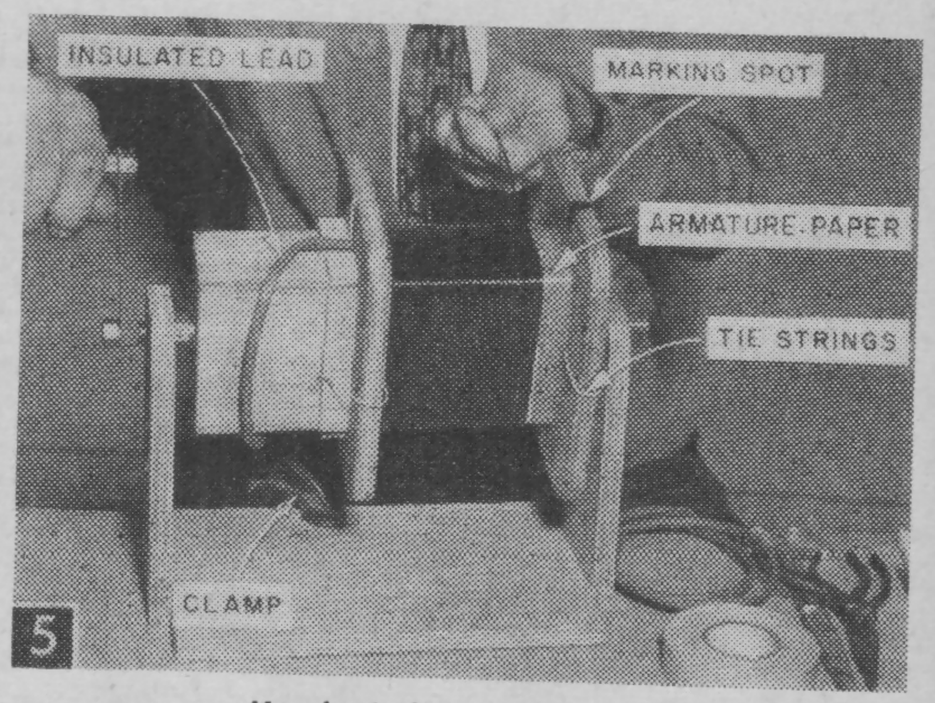
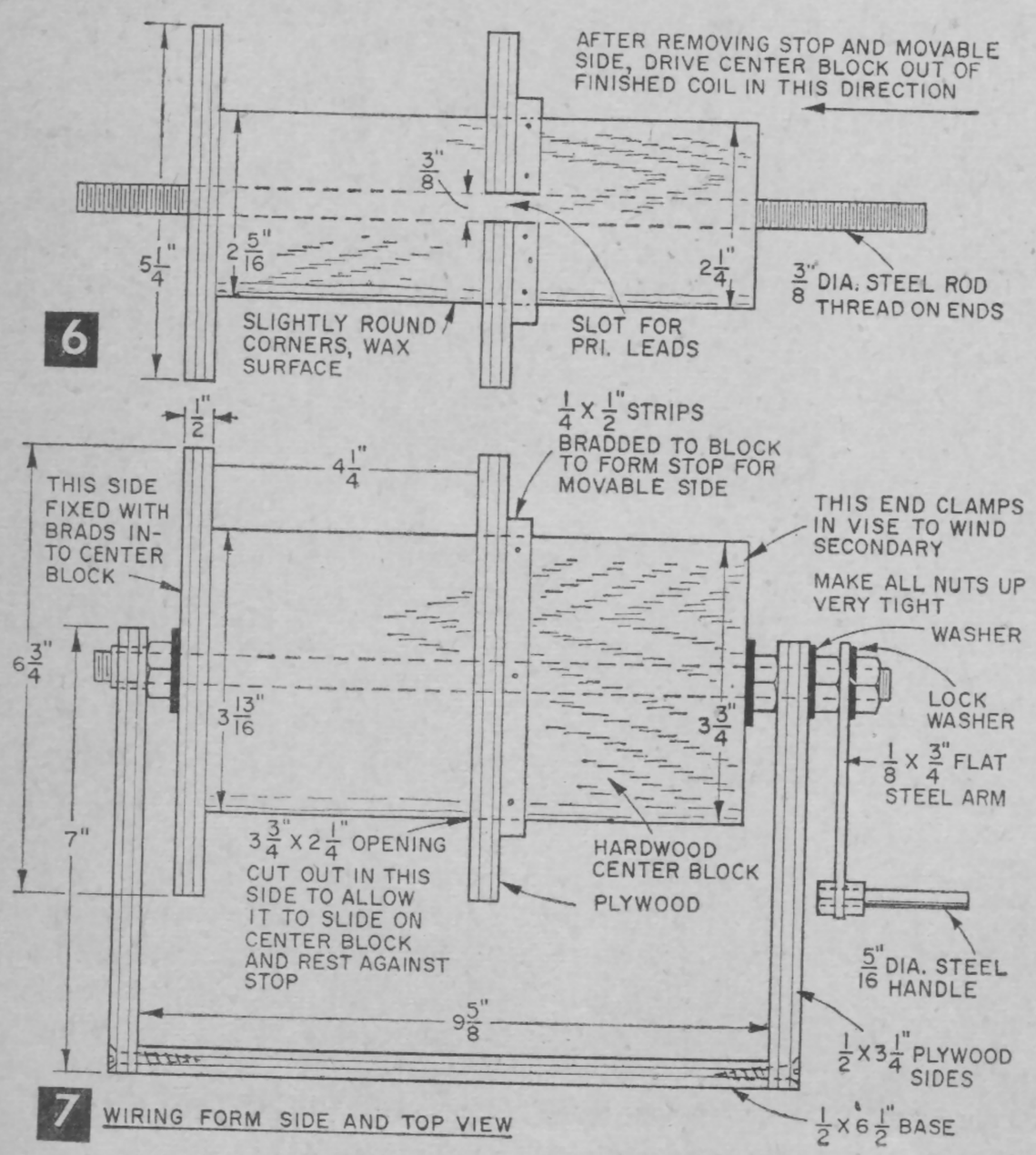


5

Hand-winding coil on form detailed in Fig. 6. Insulated tubing covers start, tap and end of windings.



7 WIRING FORM SIDE AND TOP VIEW

The necessary pressure is applied to the work with a lever which operates a Bakelite cam which presses down hard on the top or movable arm (Fig. 2). You can adjust this pressure by using the slotted holes at the cam shaft. After the work is clamped, you press a pushbutton on the control end of the unit; this pulls in a relay which connects the line to the transformer primary. Thus current is turned on and off *after* the work has been tightly clamped, insuring a minimum of burning and pitting.

The core of the transformer is made from pieces of black stove pipe iron, which is more easily obtainable than standard transformer silicon steel, and for intermittent duty works about as well.

Make Up the Winding Form from ½ in. plywood with a hardwood center block as in Figs. 5 and 6. A coat of wax, plus the

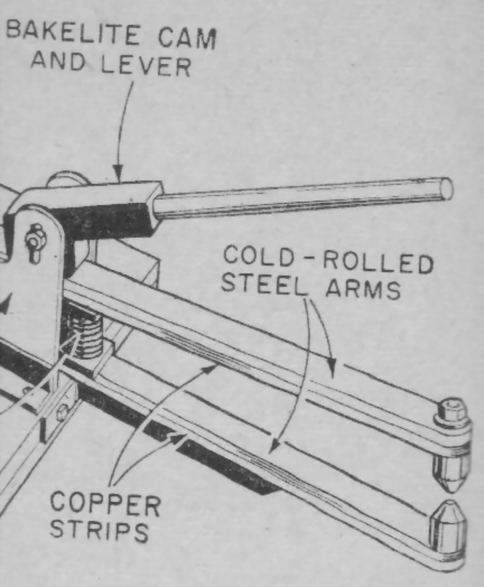
MATERIA

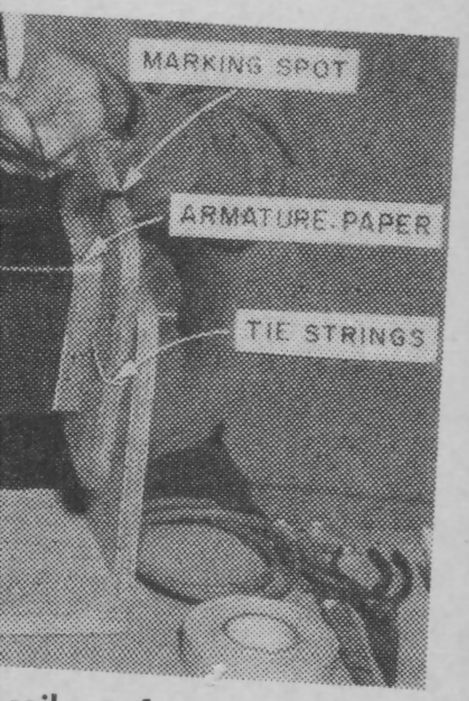
No. Req'd.	Size and Descriptio
1 pc	hardwood 1¼ x 11 x 21½
2 pcs	angle iron ⅛ x 1 x 11" (
1 pc	transite asbestos-cement b
	Approx. 42 pounds of 28 strips (core)
	Approx. 8 pounds of #12
6 pcs	12 x 32" sheet roofing co
6 pcs	copper 1/16 x ¾ x 24½"
6 pcs	copper 1/16 x ¾ x 22½"
2 pcs	copper rod stock ¾" dia
4 pcs	angle iron ⅛ x 1 x 8" (c
4 pcs	cr (cold-rolled) steel ro a distance of 1½" (core
4 pcs	cr steel 1/16 x 1" x approx
1 pc	Bakelite ¼ x 1¾ x 7½
2	rolls white cotton coil ta
8	hex nuts, 5/16"-18, and
Brass:	2 pcs. ⅛ x 1½ x 2¼"; 1 pc ⅛ x 1 x 1⅞" (for
6	auto battery braided gro of flat cable, with lugs o
Misc.:	1½" wide Mystik cloth brass screws and nuts tubing 3/16" O.D.; .010
1	heavy duty relay D.P.S. A.C. coil (or 230 volts f Struthers-Dunn #8BXX coil). Try electronic su Everett Street, Allston same specs.
1	momentary-contact push rated 1 amp, 125 volts. of higher rating. Must b
1	barrier type terminal stri
7 ft	#12-2 wire rubber cord
1	20-ampere polarized cor and 3-wire cord, with th
1 pc	alum. 3/32 x 3¾ x 4⅝"
1 pc	alum. 1/16 x 4¼ x 4½
1 pc	alum. approx. .024 x 14
	Sheet metal screws, woo terminal lugs
	We
1 pc	cr (cold rolled) steel 5/
1 pc	cr steel 5/16 x ¾ x 18
2 pcs	angle iron ⅛ x 1 x 4" (
2 pcs	cr steel ⅛ x 4 x 6" (si
1 pc	cr steel ⅜" dia. 3¼" l
1 pc	cr steel ⅜" dia. 3½"
1 pc	cr steel ¼ x ¾ x 11/1
1 pc	canvas-type Bakelite ¾
1 pc	iron pipe ¼" pipe size,
2 pcs	Bakelite ¼ x 1¼ x 15/
1	compression spring, 12 t
1 pc	cr steel 1/16 x 1" x app
1 pc	cr steel ¼ x 1 x 7½"
1 pc	cr steel ¼ x 1¼ x 4"
2	lag screws ⅜ x 3" (bra
4	⅜" hex nuts (cam shaft
2	5/16"—18 hex nuts (el
2	*fh* machine screws ¼"-2
4	*rh* machine screws ¼"-
6	¼"-20 nuts and washer
4	10-24 *rh* machine screw
2 pcs	pipe or tubing, brass or
2 pcs	same as above, ⅜" long
	Misc. nuts, screws, wash

slight taper to the bloc
it out of the coil later
the nuts very tightly
on the shaft and the c

Place two turns of
tightly around the
strong string or cord
of the block under the
of strings out of the w
to outside of the form
be used to tie up the

CABLE





coil on form detailed in ed tubing covers start, tap nd of windings.

sary pressure is ap- work with a lever tes a Bakelite cam es down hard on the le arm (Fig. 2). You is pressure by using les at the cam shaft. rk is clamped, you utton on the control it; this pulls in a re- nects the line to the primary. Thus cur- on and off *after* the en tightly clamped, inimum of burning

the transformer is eces of black stove ich is more easily n standard trans- steel, and for inter- orks about as well.

he Winding Form

wood with a hard- lock as in Figs. 5 of wax, plus the

MATERIALS LIST—SPOT WELDER

Base

No. Req'd.	Size and Description
1 pc	hardwood 1¼ x 11 x 21½" (oak, birch, maple, hard pine, etc.)
2 pcs	angle iron ⅛ x 1 x 11" (under base)
1 pc	transite asbestos-cement board ¼ x 11 x 21½" (top)

Transformer

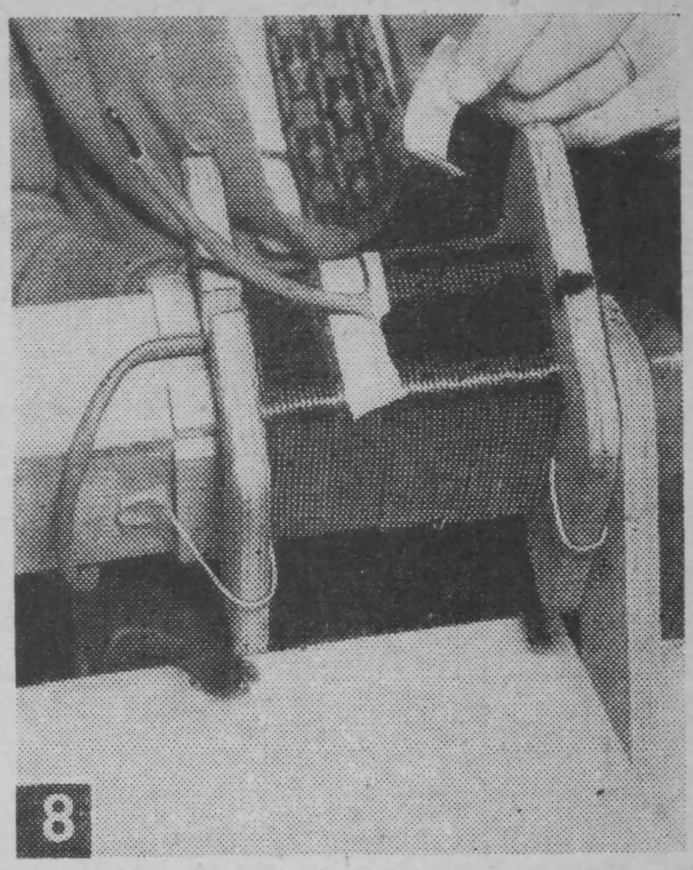
	Approx. 42 pounds of 28-gage black stove pipe sheet iron cut into 2" wide strips (core)
	Approx. 8 pounds of #12 Formvar magnet wire (primary)
6 pcs	12 x 32" sheet roofing copper about .020-.022 thickness (secondary)
6 pcs	copper 1/16 x ¾ x 24½" (conductors to electrode, lower arm)
6 pcs	copper 1/16 x ¾ x 22½" (conductors to electrode, upper arm)
2 pcs	copper rod stock ¾" dia. 2¼" long (electrodes)
4 pcs	angle iron ⅛ x 1 x 8" (core clamps)
4 pcs	*cr* (cold-rolled) steel rod stock 5/16" dia. 5" long. Thread ends 5/16"-18 for a distance of 1½" (core clamps)
4 pcs	*cr* steel 1/16 x 1" x approx. 3½"
1 pc	Bakelite ¼ x 1¾ x 7½" (terminal strip top of trans.)
2	rolls white cotton coil tape 1" wide and .007" thick
8	hex nuts, 5/16"-18, and washers
Brass:	2 pcs. ⅛ x 1½ x 2¼"; 1 pc. ⅛ x 1⅝ x 1⅞"; 1 pc. ⅛ x 1⅞ x 1⅞"; 1 pc ⅛ x 1 x 1⅞" (for terminal clamps)
6	auto battery braided ground straps, 1" wide heavy type, about 11" long of flat cable, with lugs on ends removed
Misc.:	1½" wide Mystik cloth adhesive tape; Bakelite pcs for coil wedges; 10-32 brass screws and nuts for terminals; insulating varnish; 6-ft spaghetti tubing 3/16" O.D.; .010 armature paper

Control Box

1	heavy duty relay D.P.S.T. or D.P.D.T. contacts rated 30 amp., 115 volt A.C. coil (or 230 volts for 230 volt operation). Struthers-Dunn #8BXX or old number, possibly surplus, ADBT8 (115 volt coil). Try electronic supply house or write Apparatus Service Co., 355 Everett Street, Allston 34, Mass. Could use other make of relay with same specs.
1	momentary-contact push switch, normally off (Arrow H & H type 3391-GL, rated 1 amp, 125 volts. For longer service or for 230 volts, use a switch of higher rating. Must be momentary contact, normally off type.
1	barrier type terminal strip, Jones Type 3-141
7 ft	#12-2 wire rubber cord
1	20-ampere polarized cord plug, 2-pole. For 230 volts, use a 3-pole plug and 3-wire cord, with third wire grounding the transformer
1 pc	alum. 3/32 x 3¾ x 4⅝" (switch panel)
1 pc	alum. 1/16 x 4¼ x 4½" (piece back of panel)
1 pc	alum. approx. .024 x 14 x 9" (cover). Or use 24-ga. galv. iron
	Sheet metal screws, wood screws, #12 hook-up wire, #18 hook-up wire, terminal lugs

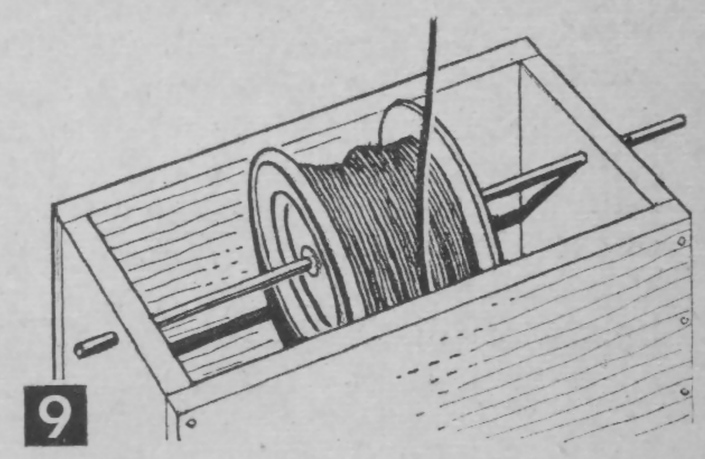
Welder Arms and Misc.

1 pc	*cr* (cold rolled) steel 5/16 x ¾ x 20" (lower arm)
1 pc	*cr* steel 5/16 x ¾ x 18¾" (upper arm)
2 pcs	angle iron ⅛ x 1 x 4" (supports for bottom of side plates)
2 pcs	*cr* steel ⅛ x 4 x 6" (side plates)
1 pc	*cr* steel ⅜" dia. 3¼" long (welds to upper arm)
1 pc	*cr* steel ⅜" dia. 3½" long (cam assembly shaft)
1 pc	*cr* steel ¼ x ¾ x 11/16" (stop for cam)
1 pc	canvas-type Bakelite ¾ x 1⅞ x 2¾" (cam)
1 pc	iron pipe ¼" pipe size, 11" long (pressure handle)
2 pcs	Bakelite ¼ x 1¼ x 1⅝" (compression spring seats)
1	compression spring, 12 turns, 1" O.D. about 3/32" dia. spring wire
1 pc	*cr* steel 1/16 x 1" x approx. 3" (term. strip brackets)
1 pc	*cr* steel ¼ x 1 x 7½" (brace under lower arm)
1 pc	*cr* steel ¼ x 1¼ x 4" (brace under lower arm)
2	lag screws ⅜ x 3" (brace under lower arm)
4	⅜" hex nuts (cam shaft)
2	5/16"—18 hex nuts (electrodes)
2	*fh* machine screws ¼"-20 x 2¼" (lower arm to base)
4	*rh* machine screws ¼"-20 x 2" (arm bracket assembly to base)
6	¼"-20 nuts and washers
4	10-24 *rh* machine screws 2" long (transformer to base)
2 pcs	pipe or tubing, brass or steel ⅜" I.D. ⅝" O.D. ¾" long (arm shaft spacers)
2 pcs	same as above, ⅜" long (cam shaft spacers)
	Misc. nuts, screws, washers, etc.



8

To make tap for 115-volt operation at the 80th turn, bring out a loop of wire, slip tubing over it, and use some adhesive tape both under and on top of the point where the wire is brought out.



9

slight taper to the block, enables you to press it out of the coil later when wound. Make up the nuts very tightly so the form will not slip on the shaft and the crank will be tight.

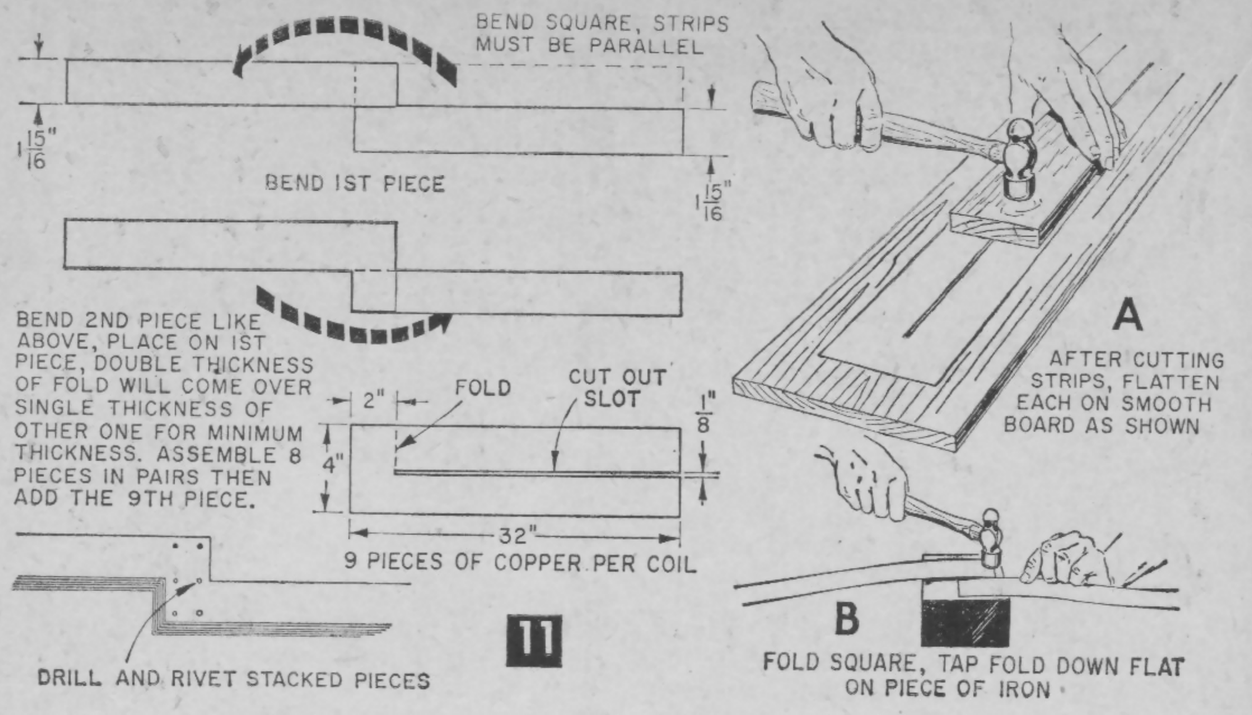
Place two turns of .010 in. armature paper tightly around the block with lengths of strong string or cord at each of the two flats of the block under the paper. Keep free ends of strings out of the way by taping them over to outside of the form sides. These strings will be used to tie up the coil when wound. Be sure armature paper comes fully up to the form sides.

Make the start end of the #12 wire about 10 in. long as a lead. Cover this lead with a piece of spaghetti insulating tubing which is then placed in the slot and wrapped around the block.

Wind the turns on evenly and smoothly with each one close together (use a piece of wood to tap them down snug and flat if you wish). Keep a careful count of the number of turns. Note the marking spot of black paint on the form side oposite the slot (Fig. 5); each time this spot comes up is one turn. Note your count down on paper occasionally to avoid an error.

For 115 volts, put 80 turns on each of the two required coils. If the welder is to operate on 230 volts, you can bring out a loop of wire at the 80th turn, equipping the looped lead with tubing for insulation as in Fig. 8, and then continue on to 160 turns, where the end is brought out. This gives you a tap for use on 115 volts in case you want it. Re-

member, though, that the coil will be larger than if you wind it for 115 volts only, and it may be necessary to alter the dimensions of the core to suit; this can be determined later. In making this tap, place adhesive tape under the tap for added insulation and then a second piece of tape over it to hold in place. Mark the start end of the winding (S), the tap (80) and the end (160) by placing white adhesive tape on the leads and marking with a pencil.



Support your reel of wire under the bench during winding as in Fig. 9. It will take around four pounds of wire if you put 160 turns on each coil, and it is well to have a little extra to make sure. Make no splices in the winding, except that an end could be made at the 80-turn tap instead of having a loop, soldering the ends together at this point later.

When the primary coil has been wound to the correct number of turns, use the strings to tie up the coil tightly on each side. Remove the base and crank of the winding jig and then clamp the center block in a large vise. Place two turns of the armature paper tightly around the primary coil as in Fig. 10. You are now ready to make up the secondary winding, which is made up of sheet copper strips (Fig. 11).

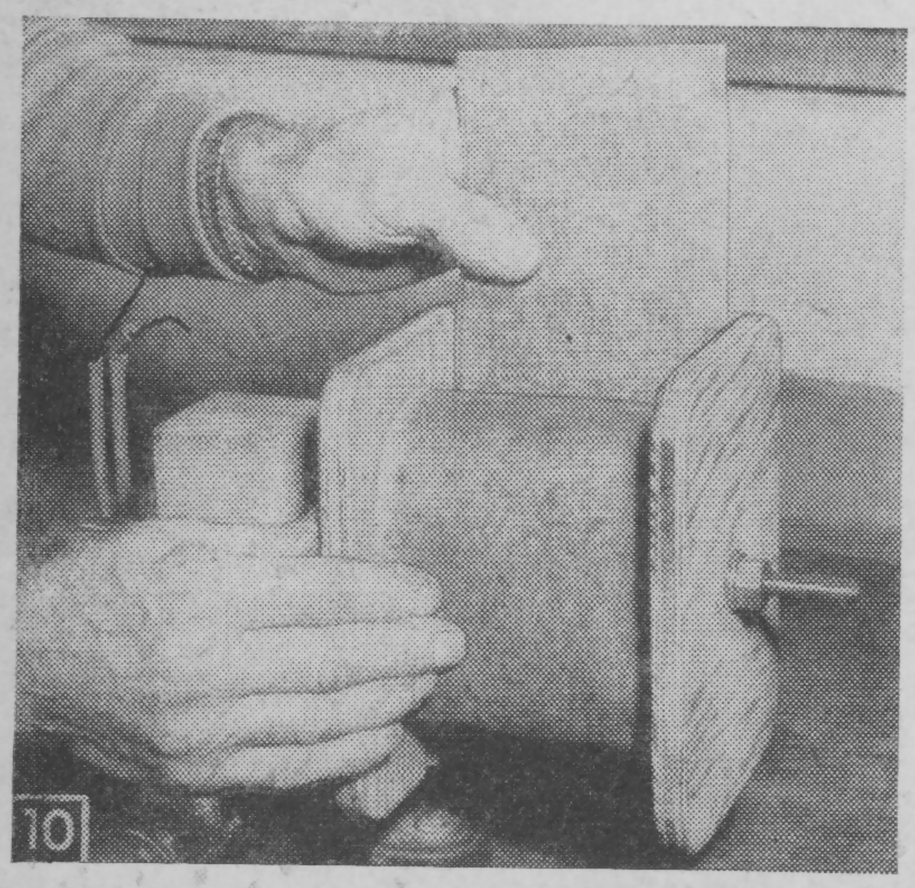
Cut the sheet roofing coppper into 4 in. wide strips, each 32 in. long to make sure that the leads or ends will be long enough to reach their terminals. Make a ⅛-in. wide slot down the exact center of each strip, to a point 2 in. from the other end. Then flatten each slotted strip on a smooth board, using a piece of wood and a hammer (A in Fig. 11). Make up nine pieces exactly alike for each of the two required coils, or 18 in all.

Next fold over each of the nine pieces as indicated in Fig. 11, and tap the folds down tightly (B in Fig. 11). These folds must be made square so that the two free ends running in opposite directions will be on a straight line with each other. The folds should also be made alternately (Fig. 11), so that a pair can be placed together with the double thickness of one fold coming over the single thickness of the previous piece when laid together. This keeps thickness of the assembled stack at a minimum. If in doubt, cut duplicate pieces from cardboard, and experiment.

Because the roofing copper comes in 12-in. width, you can obtain three 4-in. strips from each full width piece. Ask your hardware or building supply store for roofing copper about .020-.022 in. thick.

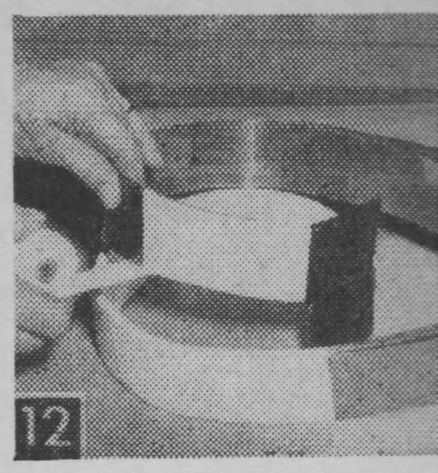
Lay the nine copper strips you have prepared together and use a small parallel clamp used to hold the center sections together. Then drill six holes through the pieces for small, low-headed copper rivets of about 1/16 in. diameter, and rivet down tightly. File off any burr the drill makes underneath, so the pieces can be drawn together tightly.

When shaping the winding to the curved form it will have when in place, keep the turns around the primary in the same direction as the primary winding. That is, when you look at the primary with the leads facing you, you'll note that the winding will go counter-clockwise if you turned the crank normally to the right, and the finish end will thus come around going to the left. When shaping the secondary winding, remember to curve it so that one end will follow the same to-the-left direction, which we will call the finish end of this winding.



Two turns of armature paper, placed around completed primary winding, insulate it from secondary winding.

Taping the Secondary Winding Strips. Insulate the center section of the secondary



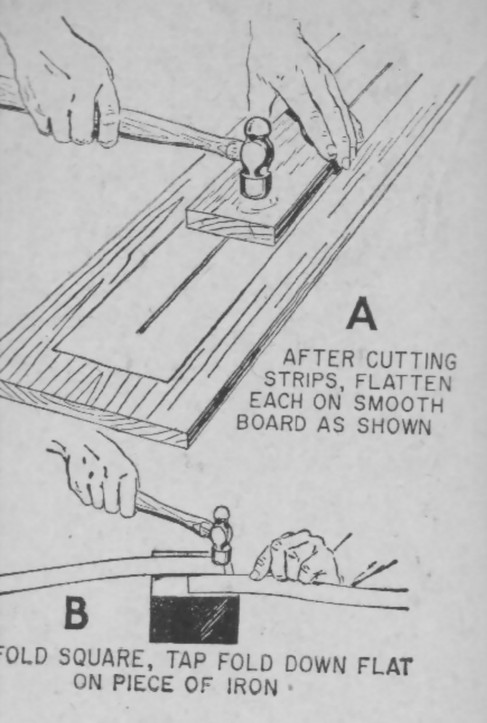
Applying cotton coil ta

winding with two lay
hesive tape (such as 1
tape sold in stores for
sure to cover the edge
faces. Then bind rest
inches from these free
coil tape as in Fig. 12,
and lapping about o
tape, sold by concerns
plies, comes in 1 in.
right for this job. B
some adhesive tape.
the conductor strips
tape it flat, the plies
wrapped the strips
primary.

Now shellac the pr
and hang up to dry
apply the secondary
With the primary le
center section is place
narrow side with a
and secured with so
one end tightly arou
turn, ending up at
bend is made and str
tie it fixed. Then car
in the opposite dire
similar turn (Fig. 13

Slip a piece of arm
center section and w
around on top of it, t
short-circuit there.
winding provides tw
brought out as leads
with a wood block a
place it in position
helps shape the coil
it fits. To provide s
between the two on
short-circuit, pull
string or cord bet
separation of about 1

Note also in Fig. 1
has been shaped wit
of the winding. With
you as shown and st
in the hand, note tha
a counter-clockwise
primary, which is
Figure 14 shows t



ch strip, to a point 2 in. Then flatten each slotted oard, using a piece of (A in Fig. 11). Make up ike for each of the two n all.

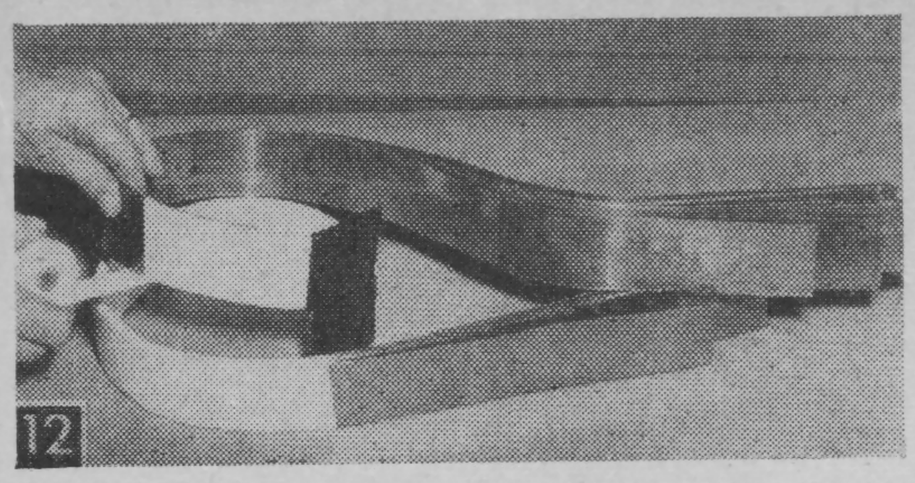
n of the nine pieces as and tap the folds down . These folds must be the two free ends run- ections will be on a other. The folds should ely (Fig. 11), so that a gether with the double coming over the single us piece when laid to- kness of the assembled in doubt, cut duplicate and experiment.

copper comes in 12-in. three 4-in. strips from Ask your hardware or r roofing copper about

strips you have pre- a small parallel clamp ter sections together. rough the pieces for er rivets of about 1/16 down tightly. File off es underneath, so the gether tightly.

inding to the curved n in place, keep the ry in the same direc- nding. That is, when with the leads facing winding will go coun- ed the crank normal- finish end will thus e left. When shaping remember to curve it low the same to-the- vill call the finish end

Winding Strips. Insu- of the secondary



Applying cotton coil tape around stacked strips.

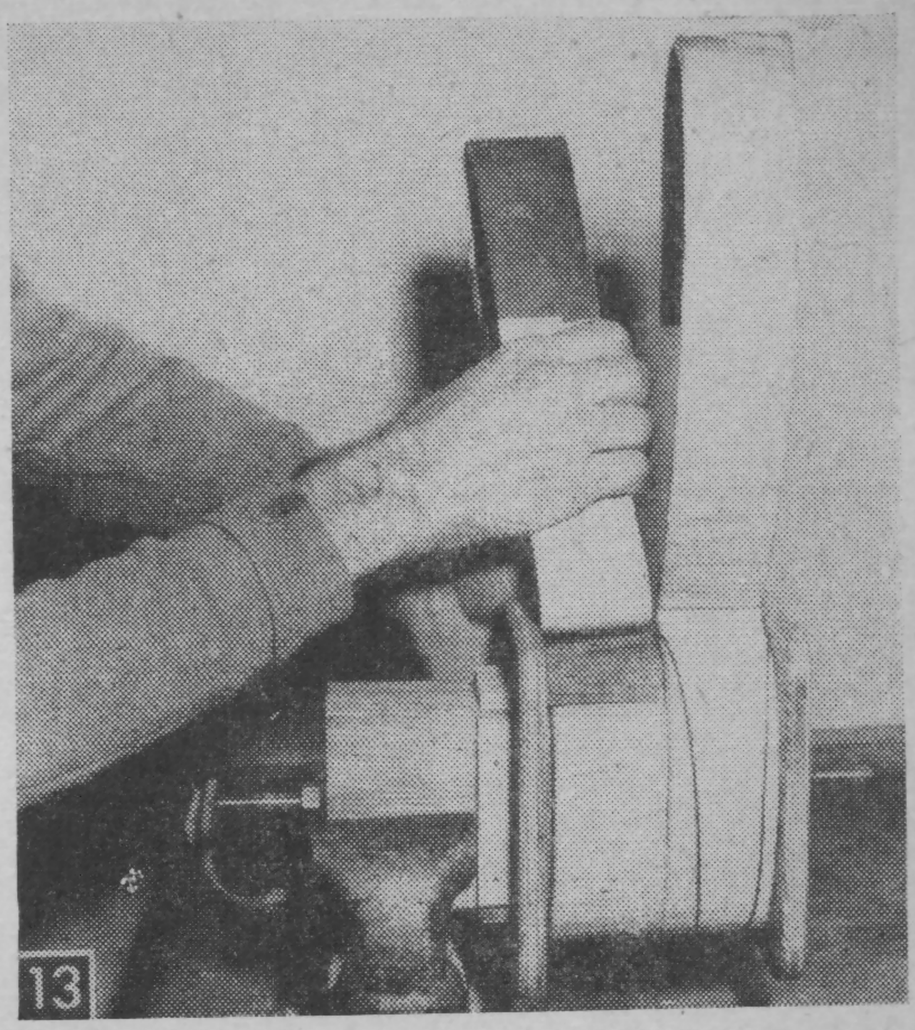
winding with two layers of a good cloth adhesive tape (such as 1½-in. wide Mystik cloth tape sold in stores for binding rug edges). Be sure to cover the edges as well as the flat surfaces. Then bind rest of strips to a point 6-8 inches from these free ends with white cotton coil tape as in Fig. 12, pulling the tape tightly and lapping about one half its width. This tape, sold by concerns dealing in winding supplies, comes in 1 in. width which is about right for this job. Bind the finish end with some adhesive tape. The taping is done with the conductor strips curved; if you tried to tape it flat, the plies would buckle when you wrapped the strips around the insulated primary.

Now shellac the prepared heavy conductor and hang up to dry for several hours. Then apply the secondary winding as in Fig. 13. With the primary leads at the bottom, the center section is placed on the top or the other narrow side with armature paper under it and secured with some adhesive tape. Carry one end tightly around to make one complete turn, ending up at the top, where a sharp bend is made and strong string is then used to tie it fixed. Then carry the other end around in the opposite direction to make another similar turn (Fig. 13).

Slip a piece of armature paper between the center section and where the two turns come around on top of it, to insure that there be no short-circuit there. In effect, this type of winding provides two turns, with both ends brought out as leads. Tap the winding down with a wood block and a light hammer as you place it in position and before tying; this helps shape the coil to the surface over which it fits. To provide some additional insulation between the two one-turn coils to prevent a short-circuit, pull several turns of heavy string or cord between them, to make a separation of about 1/16 in.

Note also in Fig. 13 how the secondary coil has been shaped with respect to the direction of the winding. With the primary leads facing you as shown and starting with the end held in the hand, note that the turns go around in a counter-clockwise rotation as they do in the primary, which is correct.

Figure 14 shows the coil being taped, after



Wrapping ends of secondary in opposite directions over the insulated primary windings.

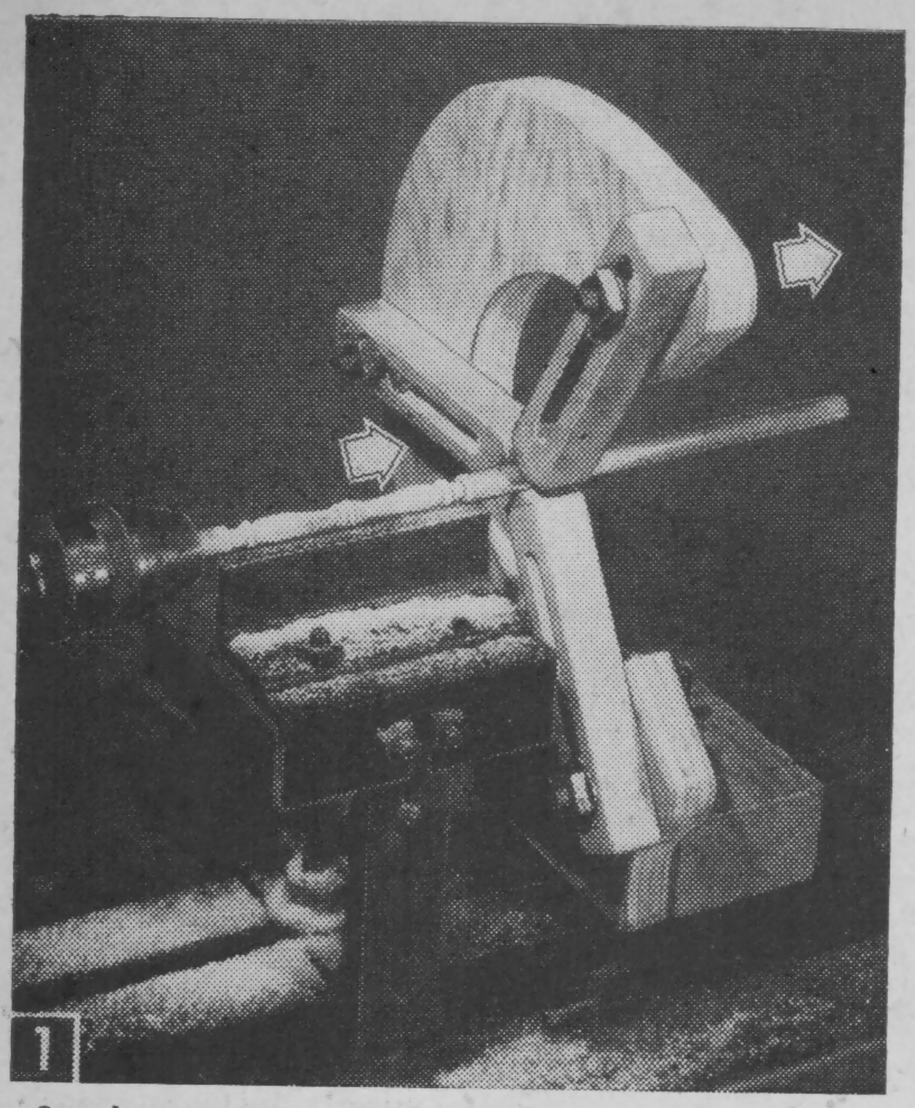
the winding form has been dismantled and the center block pressed out. Use a needle and thread to sew the tape tightly around the leads and also to hold the finish end.

Taping coil with 1-inch wide cotton tape pulled tightly and lapped for half its width.

The Second Coil. Re-assemble the form and make up another coil with both primary and secondary insulated exactly like the first one, and with the turns put on in the same direction. Then immerse the two taped coils completely in air-drying insulating varnish. Allow coils to remain about 20 minutes, then hang them up to drain, and let them dry in a warm place for about two days. This can be hastened by using infra-red lamps.

Or, if you have baking facilities, use baking varnish. Proceed the same way but bake the coils for about four hours at 250°F. or until the varnish has fully hardened.

Part 2, appearing in the June issue (on sale *April 28th*) will describe the completion of the coils and the assembly of the welder.



Steady rest moves to right as spindle is turned from left to right.

Lathe Steady Rest

THIS steady rest will handle ⅛-4½ in. dia. stock, and prevent the vibration and whipping which spoils so many turning jobs on spindly stock. It will also hold the tailstock end of the work when turning or boring that end, eliminating the need for a tailstock center.

Make a full-size drawing of steady rest body (Fig. 2A) on ¾-in. plywood. Since lathe bed shapes and distance from headstock center to top of bed rails varies, take these dimensions directly from your lathe. For a *Shopsmith,* make dimension X on Fig. 2A an inch longer than center-to-center distance between the tubular bed rails.

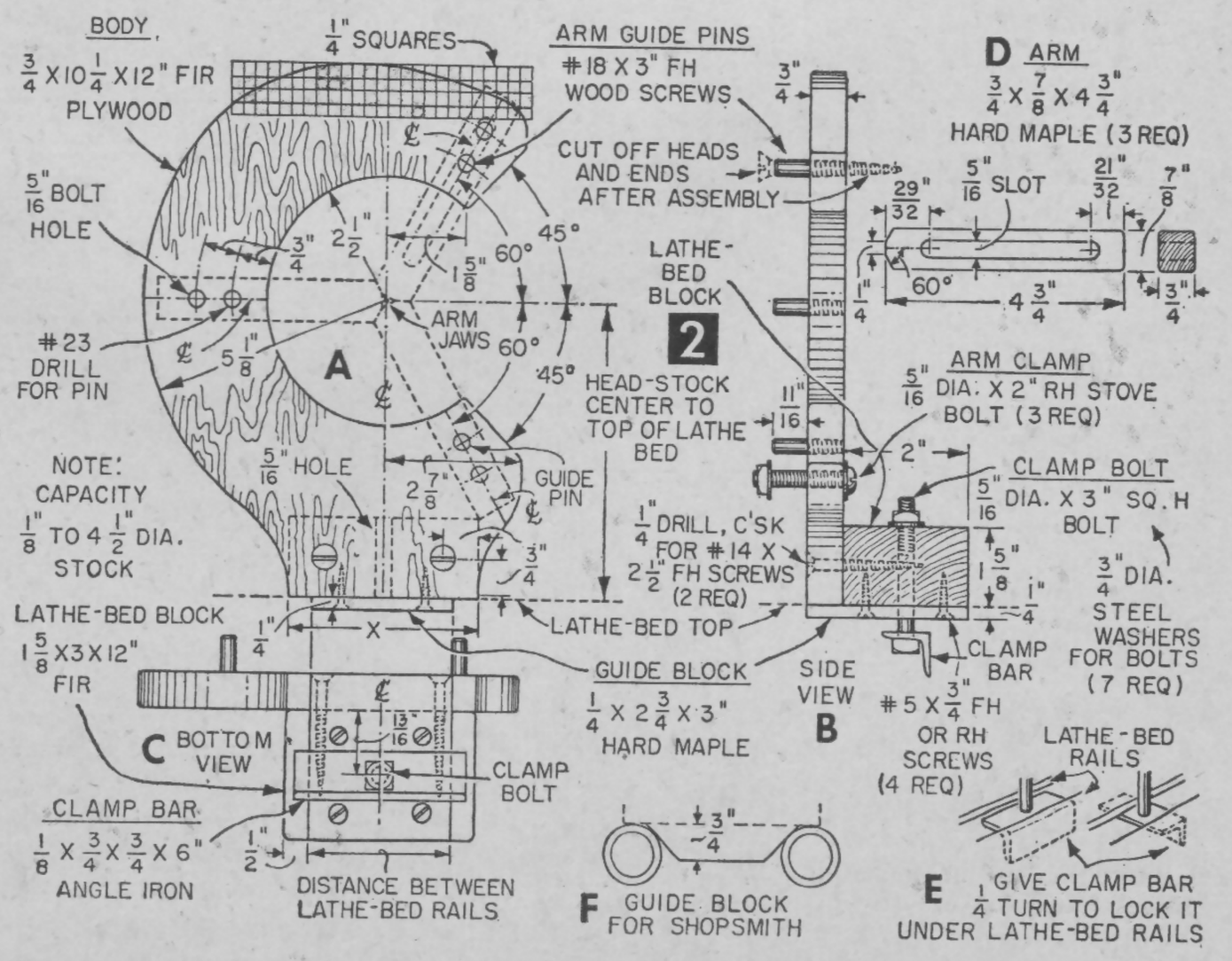
Scribe pencil centerlines on the body for arm pins and bolts, and a vertical centerline on the lower half of steady rest body. Carry this line around the bottom for centering the lathe-bed block on the body later. Saw out the body with a jigsaw or bandsaw and sand smooth, slightly rounding all sharp edges. Center punch-mark hole locations for pins, bolts and attaching-screw holes. Then bore the holes.

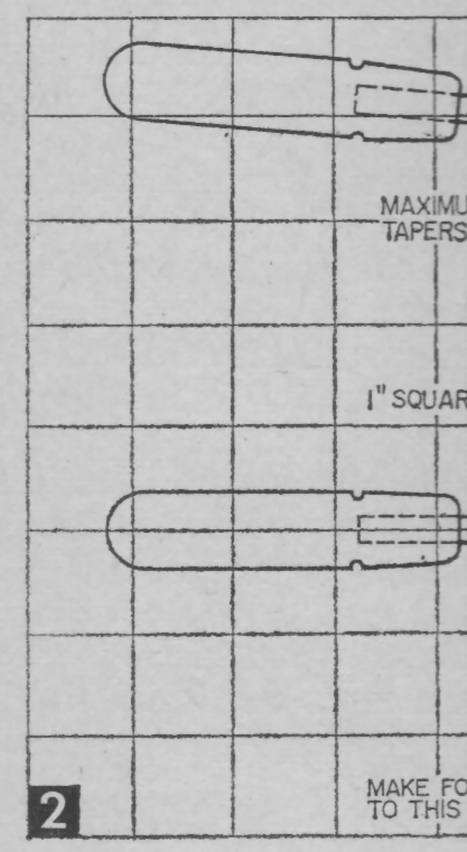
From 1⅝ x 2-in. stock, make the lathe-bed block one inch longer than the distance between the lathe-bed rails (Fig. 2C). Scribe a centerline around the block and mark the distance between the lathe-bed rails on the bottom of the block and body. Make the ¼-in. thick guide block just wide enough to slide between the bed rails. For a Shopsmith, make the guide block ¾-in. thick and bend the edges which contact the bed rails as in Fig. 2F.

Using centerlines for alignment, clamp the body to lathe-bed block and drill two 5/32-in. pilot holes into the block; then fasten with #14 x 2½ *fh* screws. Center and assemble the guide block to underside of lathe-bed block with four #5 x ¾-in. *fh* screws. Then drill a 11/32-in. clamp bolt hole through center of lathe-bed and guide blocks (Fig. 2B).

To hold center rest firmly on the lathe bed, make a clamp bar from ⅛-in. angle iron, ¾-in. longer than the distance between lathe-bed rails. Drill a 11/32-in. clamp bolt hole through center of angle iron. In use, place clamp bar lengthwise between lathe-bed rails (Fig. 2E), give it a ¼-turn, and tighten clamp bolt.

Make the three arms as in Fig. 2D. Fasten them to the body with 5/16 x 2-in. *rh* bolts. For arm guide pins, partially drive three #18 x 3-in. *fh* screws into the rest body. Cut off screw heads and projecting threads as in Fig. 2B. Lubricate arm jaws with paste wax.





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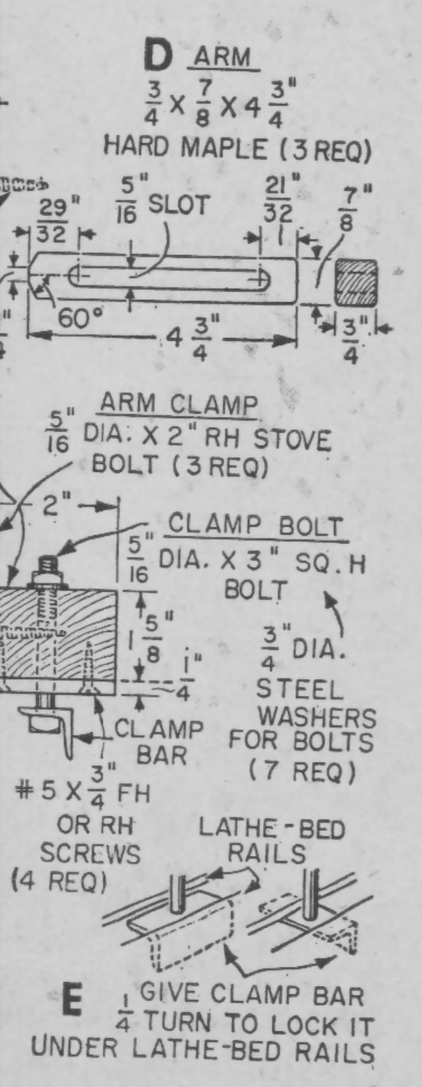
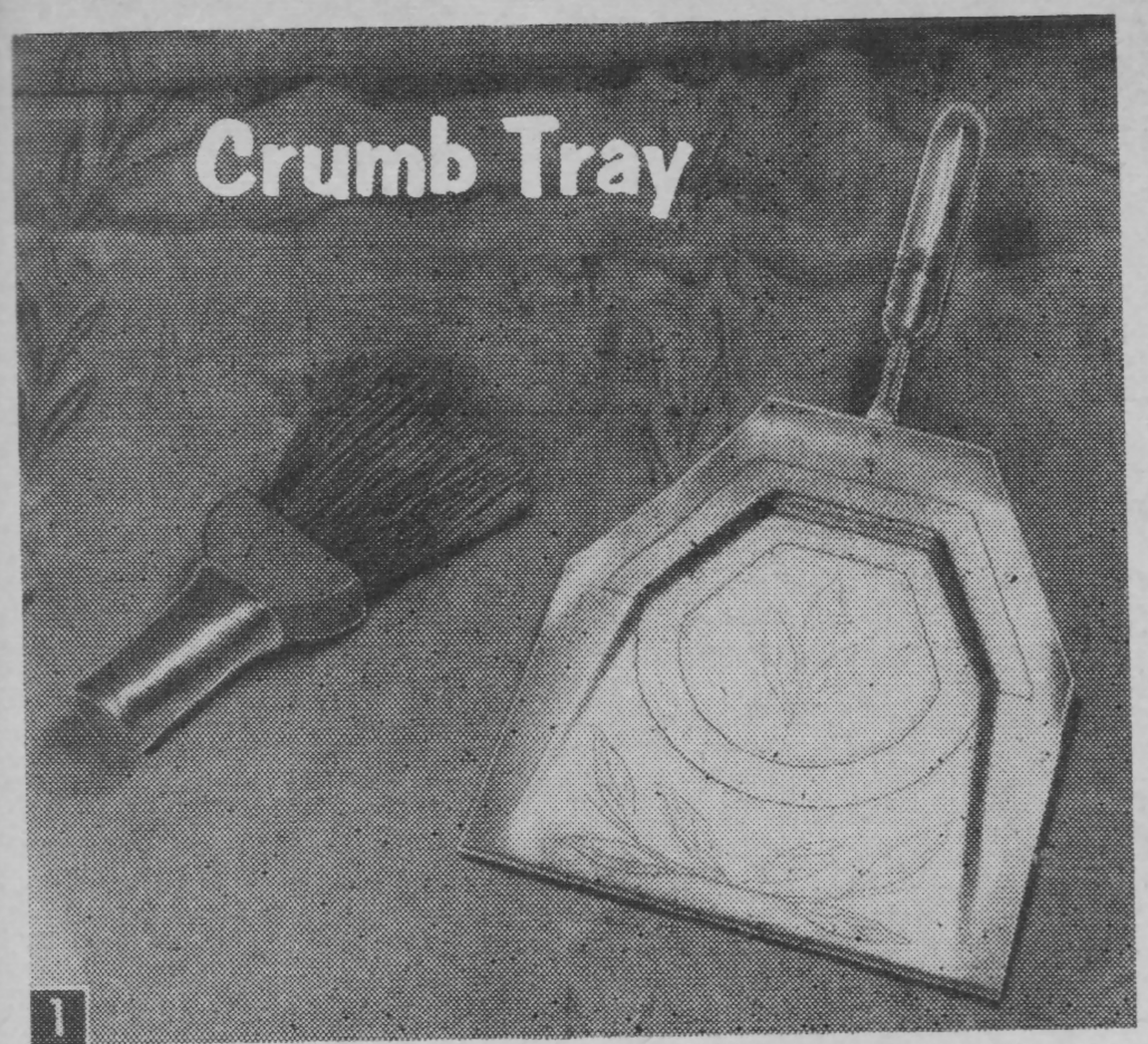


Crumb Tray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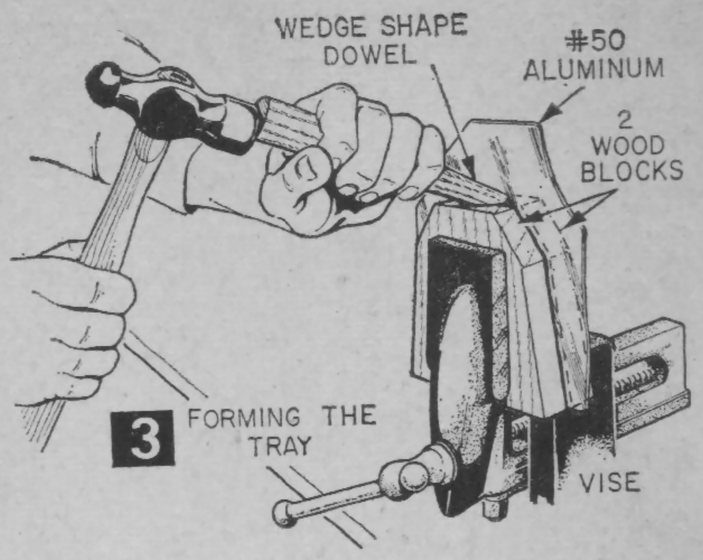
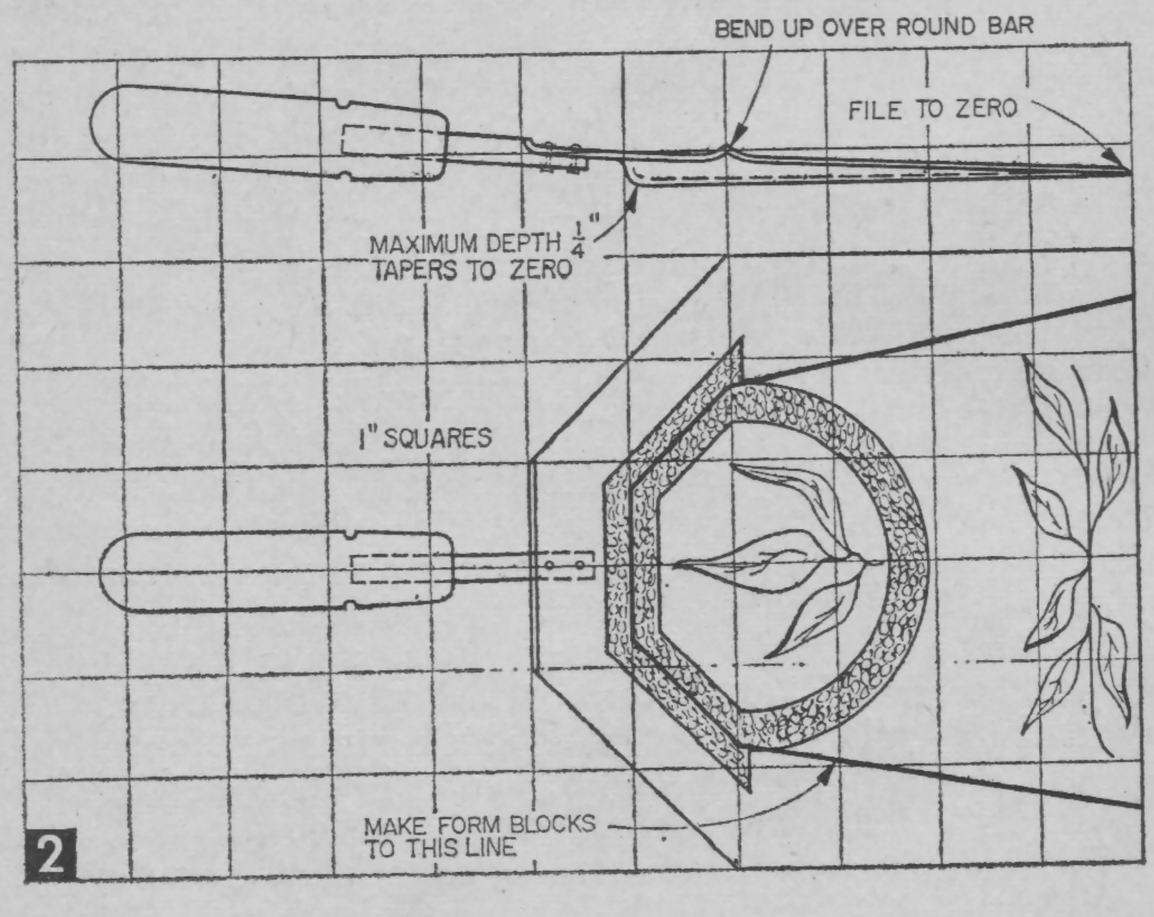


Start depression at the top, where depth is greatest (about ¼-in.) working down to zero at forward end of tray.



LIFE is not such a crumby deal for wives who receive this attractive set.

Start by laying out the shape of the tray (Fig. 2), and cutting it with shears, band saw or jig saw to size from a 1/16 x 6 x 6-in. piece of SO aluminum. Make two form blocks to the size indicated—in pine if you make just one tray, in maple if you intend to make more. Smooth off edges to about ⅛ in. radius, then place the aluminum blank between the blocks and grip in the jaws of a vise.

Use a large dowel—wedge-shaped at one end—to form the depression in the tray as in Fig. 3. Any wrinkles that appear along the edges can be removed later.

With the depression finished, place tray on a flat metal surface and tap out the wrinkles and dents with a mallet. Start by working with bottom of the tray down, then turn it over to finish the job. Don't strike too hard if you use a metal hammer; light blows do the job without leaving marks that have to be removed.

After laying out the design, use the round end of a ball-peen hammer to pebble shadowed areas (Fig. 2). Use an old sharpened screwdriver blade (light blows) to incise the leaf designs.

Turn up the back edge of the tray and the two corners by tapping lightly with hammer or mallet while you hold the aluminum over a ½-in. diameter bar or pipe.

For the handle, drill a ¼-in. concentric hole in one end of a ¾-in. diameter by 3-in. piece of Plexiglass or Lucite. Then, peen one end of a ¼-in. diameter by 2½-in. piece of drill rod so it will be a tight fit in the hole. Force drill rod into the plastic and then chuck the rod in the drill press and file the plastic to shape. When you have the shape (Fig. 2), use a slow speed and very fine sandpaper to smooth the plastic. Finish by buffing with red jeweler's rouge.

Shape the free end of the drill rod to fit the back edge of the tray, then bend the rod at the contact point up about 5°. Drill the holes for the 1/16-in. diameter x ⅜-in. aluminum rivets and attach the handle.

Working the aluminum over with a fine wire brush will give you a satin finish. Buffing will make it bright and shining. Buy the brush in a dime store and force 1-in. diameter x 3-in. aluminum tubing over the original handle. File a 1-in. diameter x 1/16-in. aluminum disc to fit nicely over the open end of the tube and secure it in place with some Plastic Aluminum. When the Plastic Aluminum is dry, file off the excess and buff to brighten it.—R. J. DeCristoforo.

Building a Buffet Cabinet

BY MILT EVANS

Buffet cabinet viewed from the dining area side. Linen closet, telephone desk and pylon cupboard are on other side of unit.

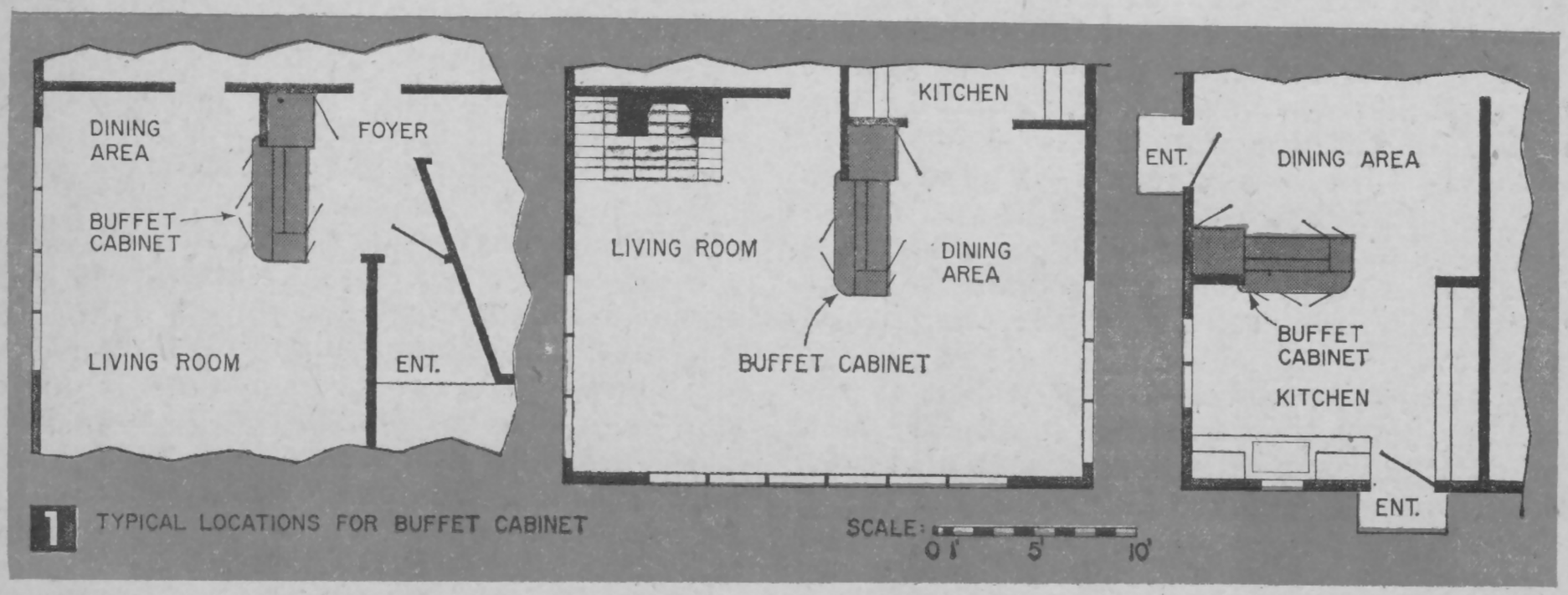
DESIGNED so that it will integrate with two wall heaters if desired, this buffet cabinet is just as useful—and decorative—in a home having other heating arrangements. If built for use without the radiator shells, for example, space allotted to them may be converted to cupboard use or simply closed over.

Besides buffet, the unit has a built-in telephone desk with cupboard below, and a commodious linen closet with storage spaces above and below. Glass above the buffet shelves admits light while sealing off sounds from the service areas of the home. Fig. 1 gives suggested locations.

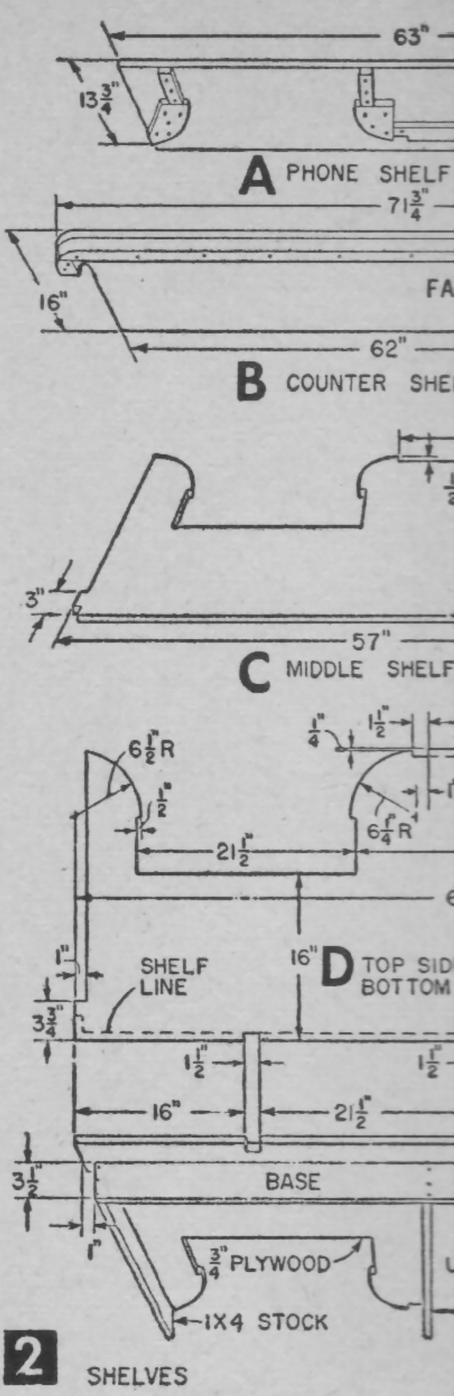
Note that the middle and bottom shelves (Fig. 2C and 2D) extend through the assembly. Cut these large pieces first, using scraps for smaller ones. Use solid stock for the base (Fig. 3), toe-nailing it to the bottom shelf (Fig. 2D) from below. The curved end of the base is cut from scraps of 2 x 4-in. lumber with an additional piece thick enough to fill it out to 3½-in.

The counter shelf (Fig. 2B) projects 1½-in. beyond the cabinet on the dining-area side with a solid strip on its front edge, and blocks at either end. To facilitate bending the plywood around the curved right end of the cabinet, do not install the outer blocks on that end of the counter shelf until the curved plywood side is in place. Stiles and guide runs are cut from 1-in. stock 1½-in. wide. Shelf edges are set back the thickness of the stiles.

Locate the front edge of the buffet—it projects 3¾ in. beyond the stub wall (Fig. 1) —by measuring from the opposite wall of the



1 TYPICAL LOCATIONS FOR BUFFET CABINET



2 SHELVES

MATERIALS LIST—

Quantities and amounts of material the location and actual size of th stallations the following will be ad

5	4 x 8′ sheets ¾″ five-ply ply
2	4 x 8′ sheets ¼″ plywood
50′	1 x 8″ common boards
28′	1 x 1½″ stock
24′	⅜ x ¾″ window stop
	scrap 2 x 4″ stock
18	½ x ½ semi-concealed offset
	Elmer's glue; Firzite sizing;
	glass to fit; plastic strip for

dining area. On a wooc nailed directly to the s floor, position it by against the stub wall s slight unevenness in a the bottom shelf by s scribing it to fit all alon over-all construction o foyer sides respectivel assembly from the botto that the foyer edges sides of the telephone-d are rabbeted so that t wood can be nailed aga

The linen-closet side knee-hole opening (Fi from the desk top do ¼-in. plywood can be gin in-place assembly

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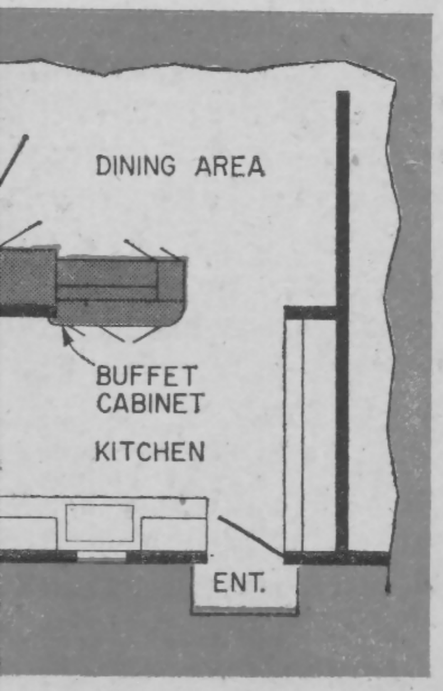

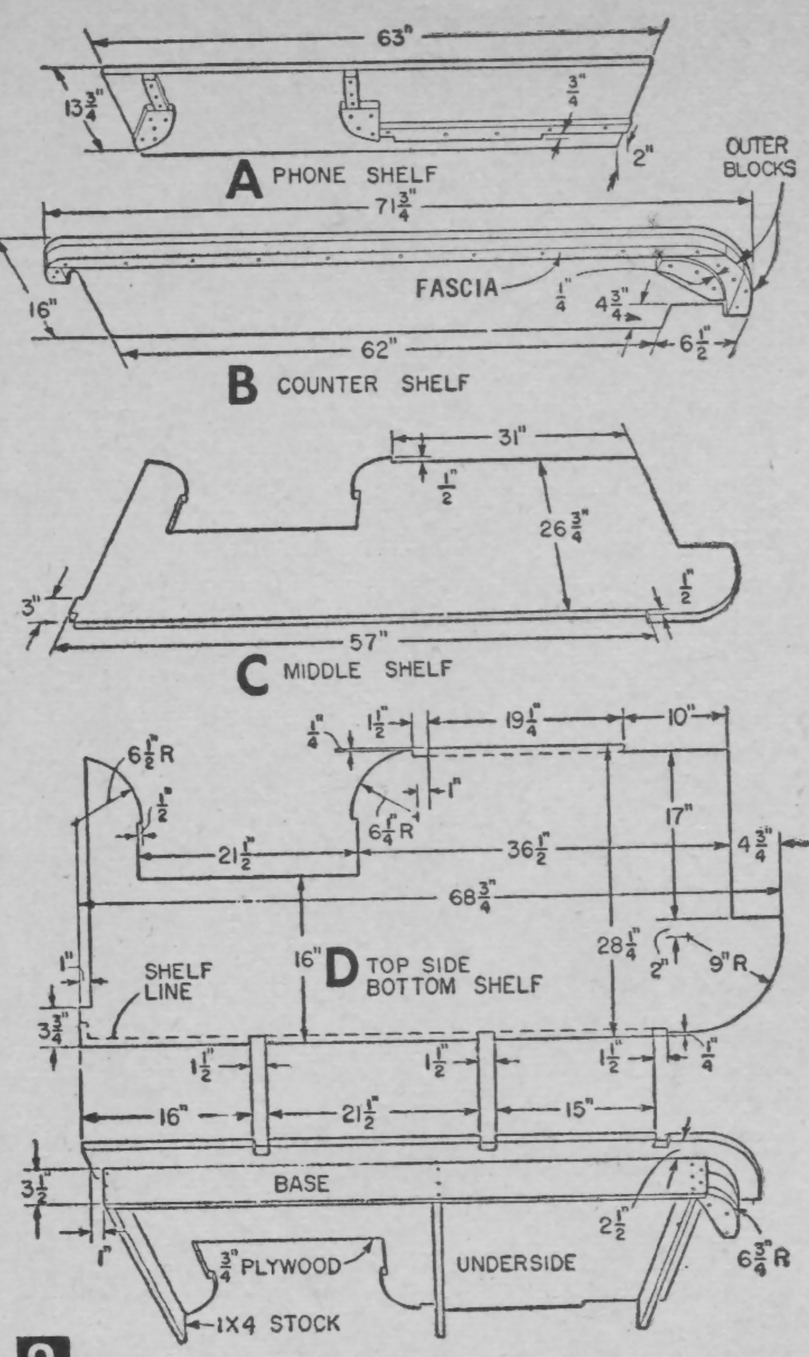

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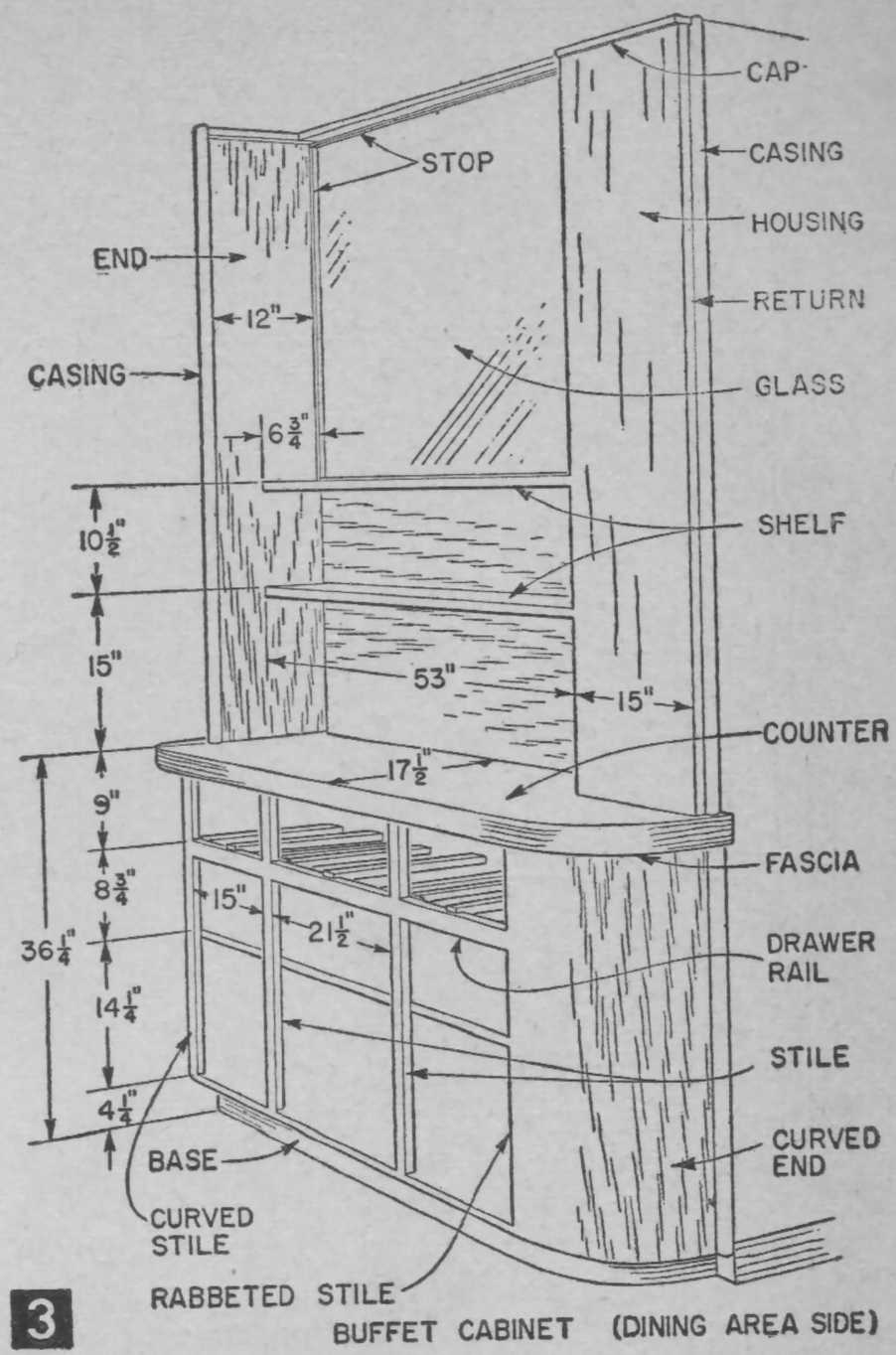


3 BUFFET CABINET (DINING AREA SIDE)

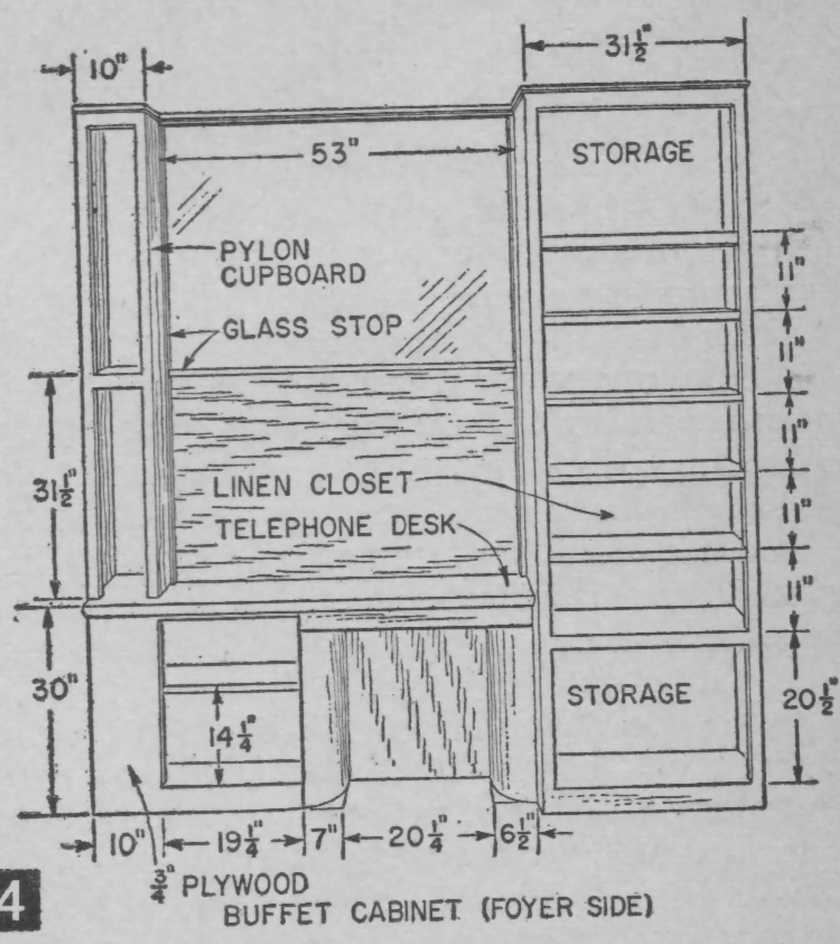
MATERIALS LIST—BUFFET CABINET

Quantities and amounts of material needed will vary depending upon the location and actual size of the unit you build. For most installations the following will be adequate:

5 4 x 8′ sheets ¾″ five-ply plywood
2 4 x 8′ sheets ¼″ plywood
50′ 1 x 8″ common boards
28′ 1 x 1½″ stock
24′ ⅜ x ¾″ window stop
scrap 2 x 4″ stock
18 ½ x ½ semi-concealed offset cabinet hinges
Elmer's glue; Firzite sizing; 6d and 3d finish nails; ¾″ brads; glass to fit; plastic strip for base

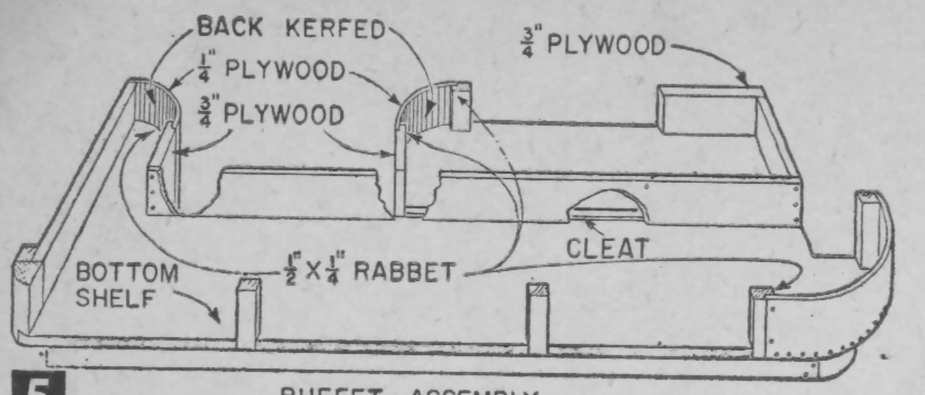
dining area. On a wood floor the base can be nailed directly to the subfloor; on a concrete floor, position it by blocking and nailing against the stub wall studs. There may be a slight unevenness in a concrete floor, so level the bottom shelf by shimming the base or scribing it to fit all along. Figs. 3 and 4 show over-all construction of the dining area and foyer sides respectively. Fig. 5 details the assembly from the bottom shelf upward. Note that the foyer edges of the ¾-in. plywood sides of the telephone-desk kneehole opening are rabbeted so that the curved ¼-in. plywood can be nailed against it.

The linen-closet side facing on the desk's knee-hole opening (Fig. 6), is also notched from the desk top downward so that the ¼-in. plywood can be nailed against it. Begin in-place assembly of the buffet cabinet's

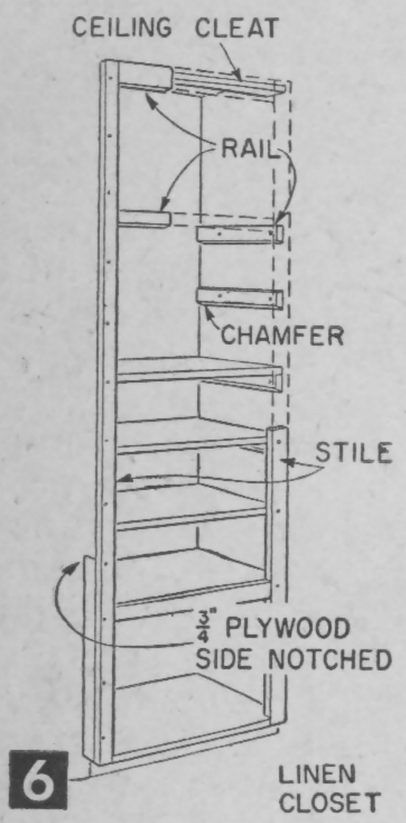


4 BUFFET CABINET (FOYER SIDE)

shelves and drawers by blocking up this side until the upper end touches the ceiling and nail it, plumbed in both directions, to the stub wall. Then make a short plywood end to nail upright on the bottom shelf to support the right end of the middle shelf. The middle shelf end which butts against the linen closet is held up by a cleat. Use 6d finish nails every 3 in. to fasten the shelves, making sure that the front edge of the middle shelf is plumb



5 BUFFET ASSEMBLY



6

with the notches in the bottom shelf. Install the counter shelf by a similar procedure. For the shelf backs, use ¼-in. plywood.

Assemble the stiles in their notches with nails and glue, dress the joints flush, and fit the drawer rails between, guiding on a leveled line. Fig. 7 illustrates the proper method of toenailing into the edges of rails, using a prop underneath to keep the ends from being driven down. After the tops are nailed, drive nails into the lower edges. Reinforce with blocks glued and nailed behind stiles and rail ends.

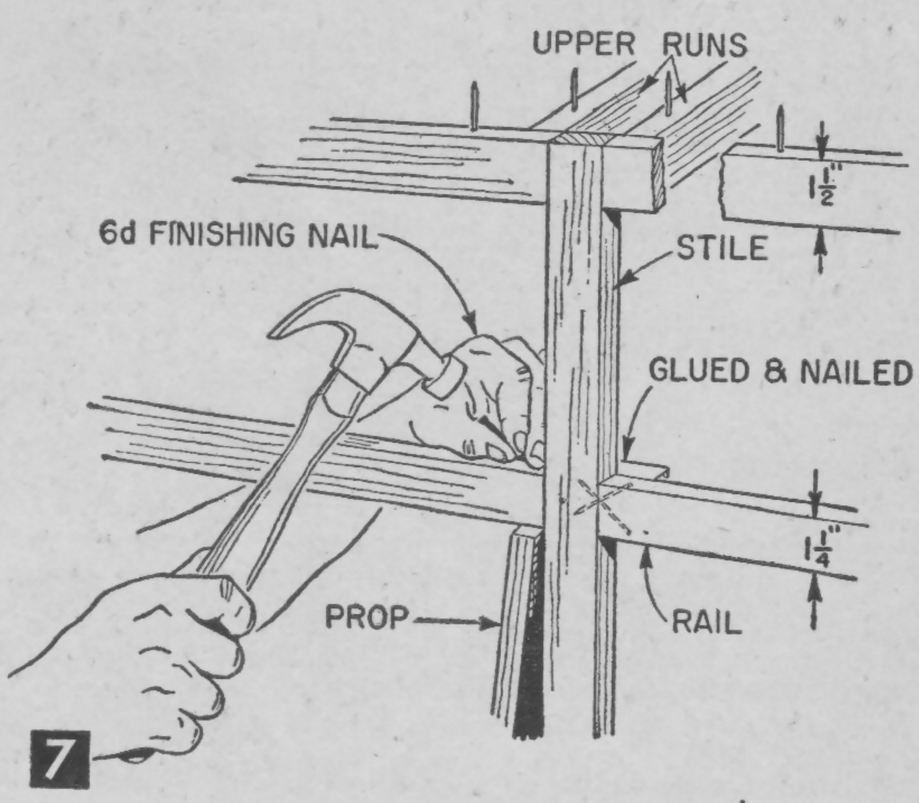
Bending the ¼-in. plywood around the right end of the buffet cabinet is a little tricky, but can be done neatly by cutting the piece to fit, with a little extra width, and soaking the outside, thereby improving flexibility and swelling the outer ply to cup the sheet in the direction of bend. Apply glue to the edge of the sheet and to the rabbet in the stile receiving it, and tack that edge every 2 in. with ¾-in. brads. After allowing the glue to set a little, place clamps at top and bottom, bend the sheet as far as possible with knee pressure, and clamp, as in Fig. 9. Nail into the shelves every 1 in. with 3d finish nails, beginning at the glued stile and working toward the other edge. As work progresses tighten the clamp until the plywood meets the other stile. Nail it there and leave clamps on until the work is dry. Then screw the fascia or outer blocks (Fig. 2B), under the curved end of the counter shelf.

To bend ¼-in. plywood under the telephone desk, saw kerfs lengthwise half-way through the thickness, about ¼-in. apart (see Fig. 5), and after soaking apply by the same methods used at the right end of the cabinet.

Erect the pylon cupboard, mitering the corners and gluing and nailing them. Then install the two upper buffet shelves. Drawers are made with center guides, permitting ample side clearance in the drawers and insuring precision operation. Rabbet the front ends of the guides, lapping them over the rail edges, and nail in place, tightening a clamp on the rails where a jaw supports an end being nailed (Fig. 8). Square and level the runs back from the rails, nailing the back ends through the plywood. Adding side runs is optional, but upper runs (Fig. 7) must be placed at the sides of the drawer openings to prevent the drawer fronts from sagging when opened.

To install shelves in the linen closet (Fig. 6), plumb a guide line on the main wall to which the stub wall attaches. Level lines on the wall and buffet end to guide in placing shelf bottoms. Then nail cleats to the wall with 8d finish nails driven into studs.

Shelves can be made of knotty pine and shellacked for a handsome interior finish. Joint two boards, apply glue, and clamp



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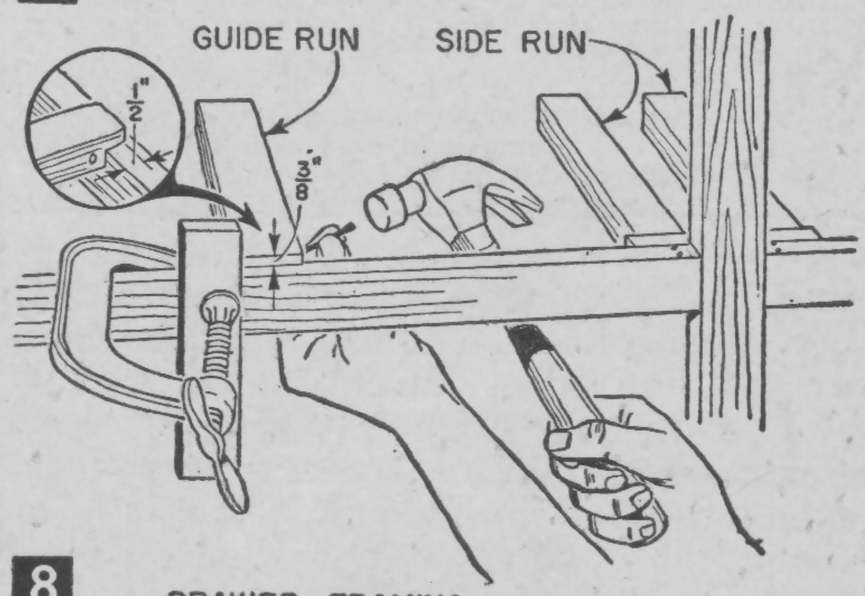
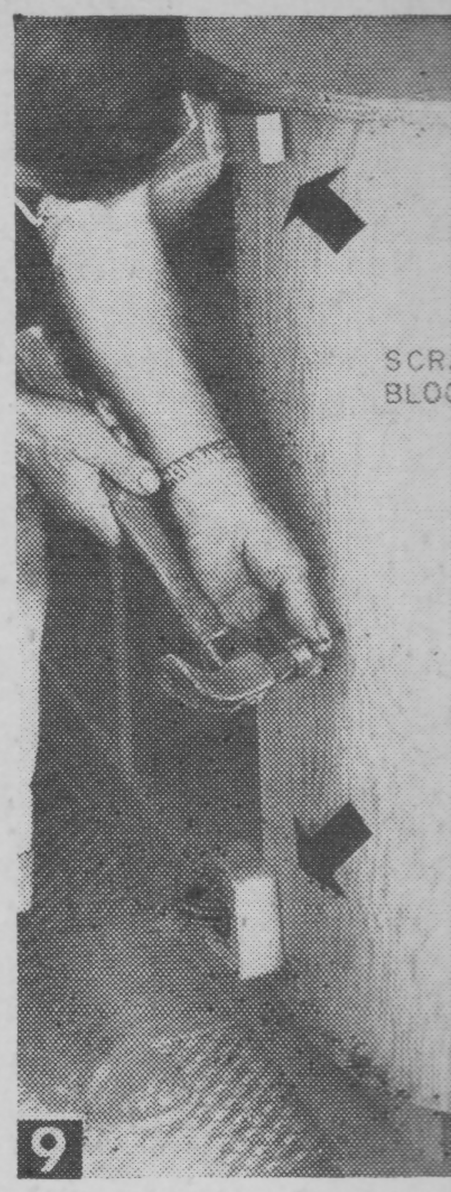


8 DRAWER FRAMING

together. Toenail a 6d finish nail into each end to hold the pair together, remove the clamps and set the pair aside to dry. To fit a shelf, cut it ½ in. less in width than the depth of the closet. This leaves a crack at the back, rather than a hard-to-dust corner.

Make the cabinet doors of ¾-in plywood ⅝-in. wider and longer than the openings they are to fit, and rabbet them ½ x ⅜-in.



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Bending and nailing the end of the cabinet w

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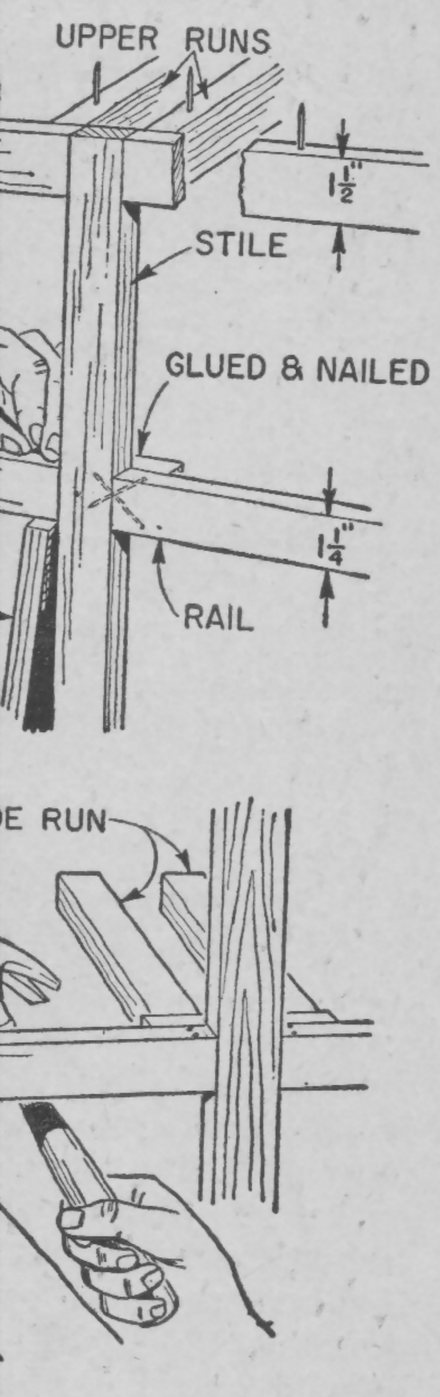

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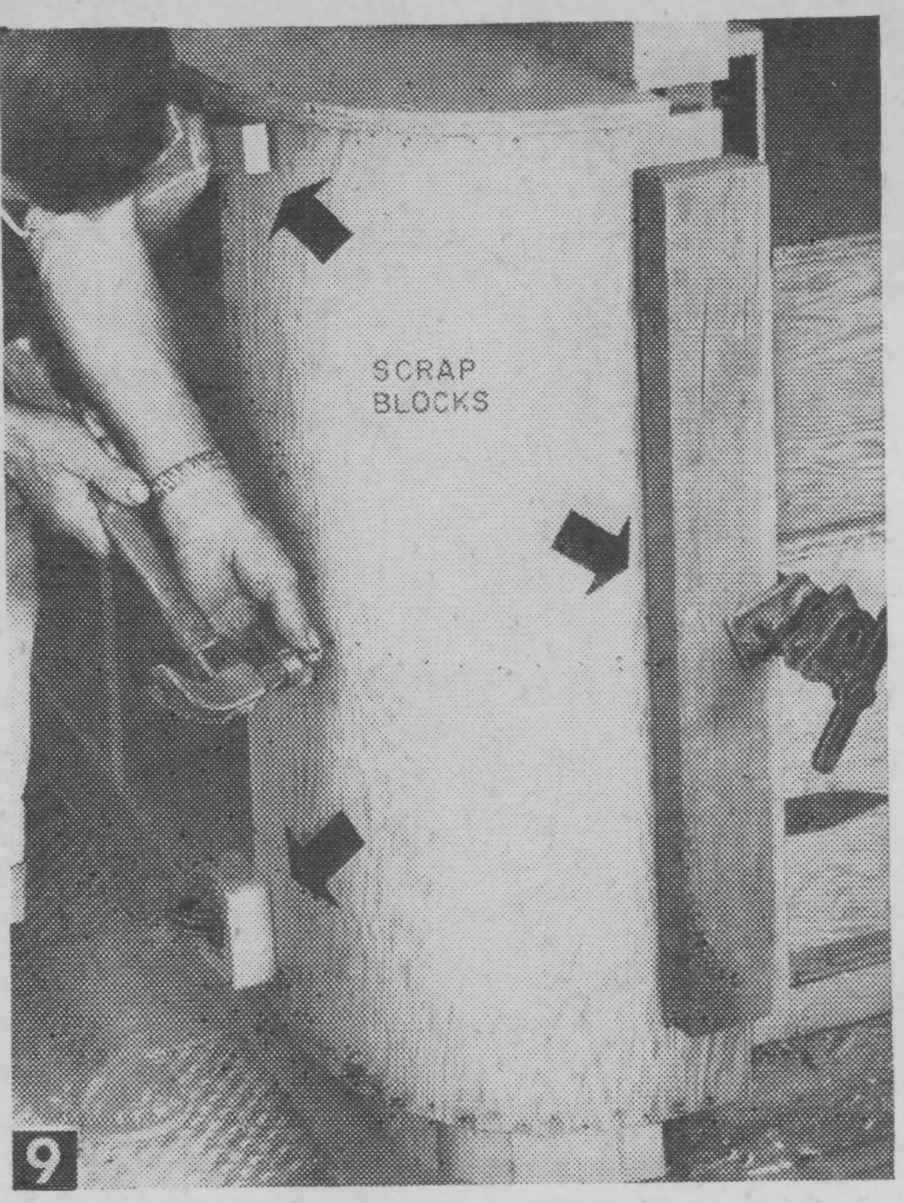


9

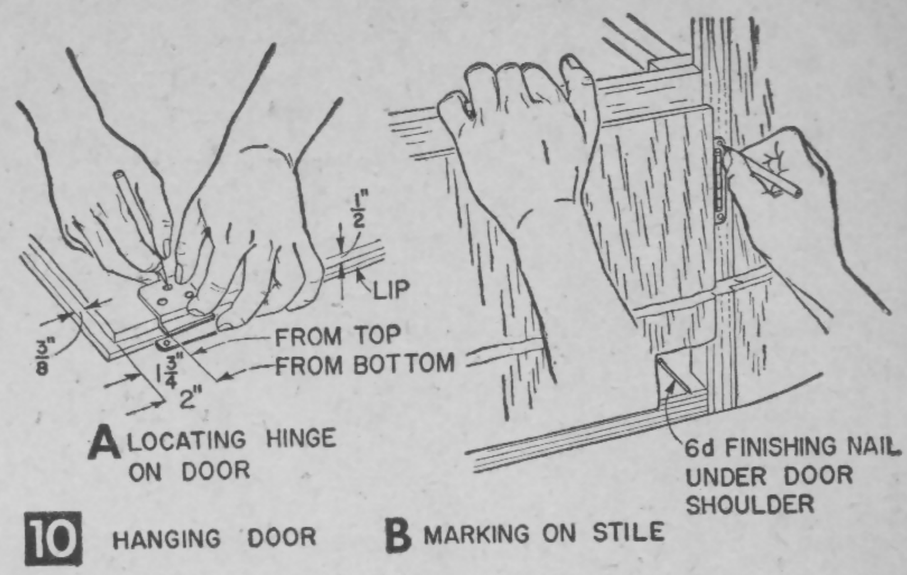
Bending and nailing the ¼-in. plywood at the right end of the cabinet with the aid of clamps.

Apply ½ x ½-in. semi-concealed offset cabinet hinges (Fig. 10A) and hang a door by resting the lower end on nails to give clearance. Divide up the side clearance, holding the door firmly in position while marking for screw holes in the stile (Fig. 10B). On the dining area side, align tops and bottoms by marking with a straightedge and dressing them as required. Plane the side lips for a 1-in. space between doors.

Make drawers by rabbeting ends and tops of the fronts and rabbeting the sides to receive the back (Fig. 11). Groove the three members ⅜-in. from the lower edges to receive the plywood bottoms, and make the backs to fit above bottoms, so that frames can be assembled and the bottoms slipped in afterward. If bottoms fit too tightly, taper them slightly with a block plane on the under sides.

To fit a drawer, set it in its opening and run a pencil along the bottom against the sides of the guide run. Use these pencil lines as location marks when nailing on the guide strips. Drive brads through the bottom into the back of the drawer and slanting into the sides to keep the drawer from racking out of square. Chamfer the forward end of the guide run and the back ends of the guide strips and rub with paraffin for easy sliding.

With the drawers fitted, align the ends with the door edges and mark the ends of the fronts. After cutting these, align the upper edges, giving them working clearance under

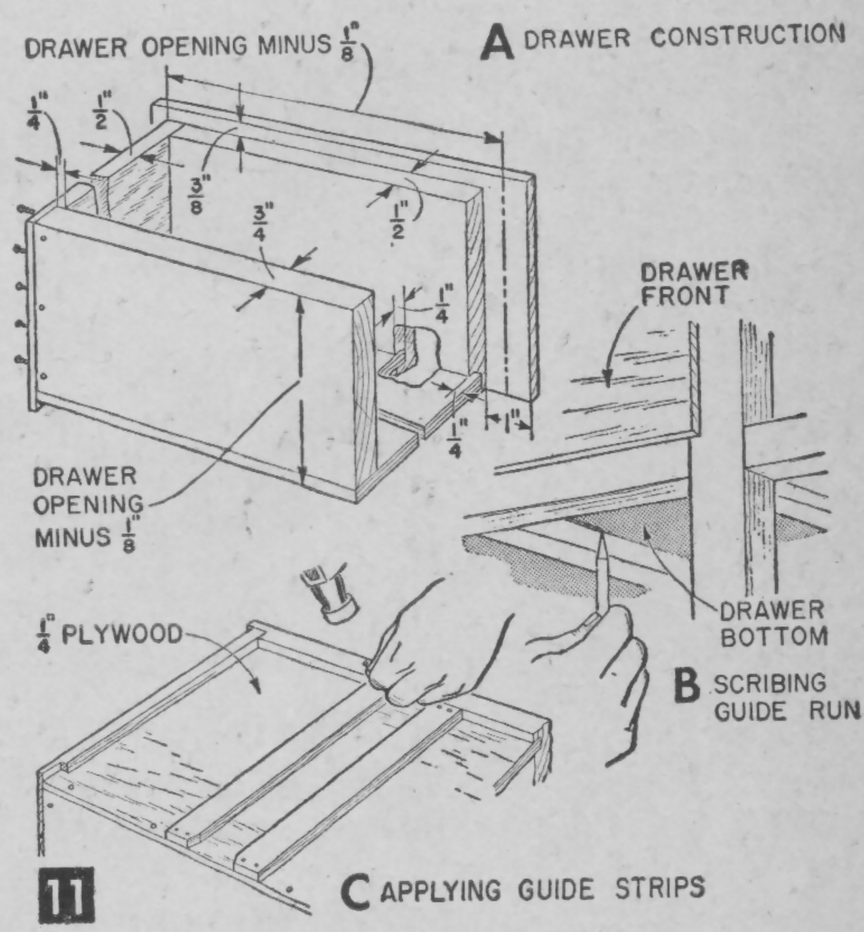


10 HANGING DOOR

the fascia.

Hang a pair of doors to the linen closet and single doors to the storage compartments above and below. A single door closes the cabinet under the telephone desk, and one or two doors close the pylon cupboard.

Run a piece of ¾ x ⅜-in. window stop along the back of the top buffet shelf, projecting ⅜ in. above for a ledge. Then run a similar strip up the ends and across a strip of 1 x 3 nailed to the ceiling to provide for installation of the glass. The ceiling strip can be made thicker to reduce the glass to stock height. Install the glass by entering it from the dining area side and securing it with stops from the other side.



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Hide the joint between ceiling and unit by strips of stop forming a band around the top of the cabinet.

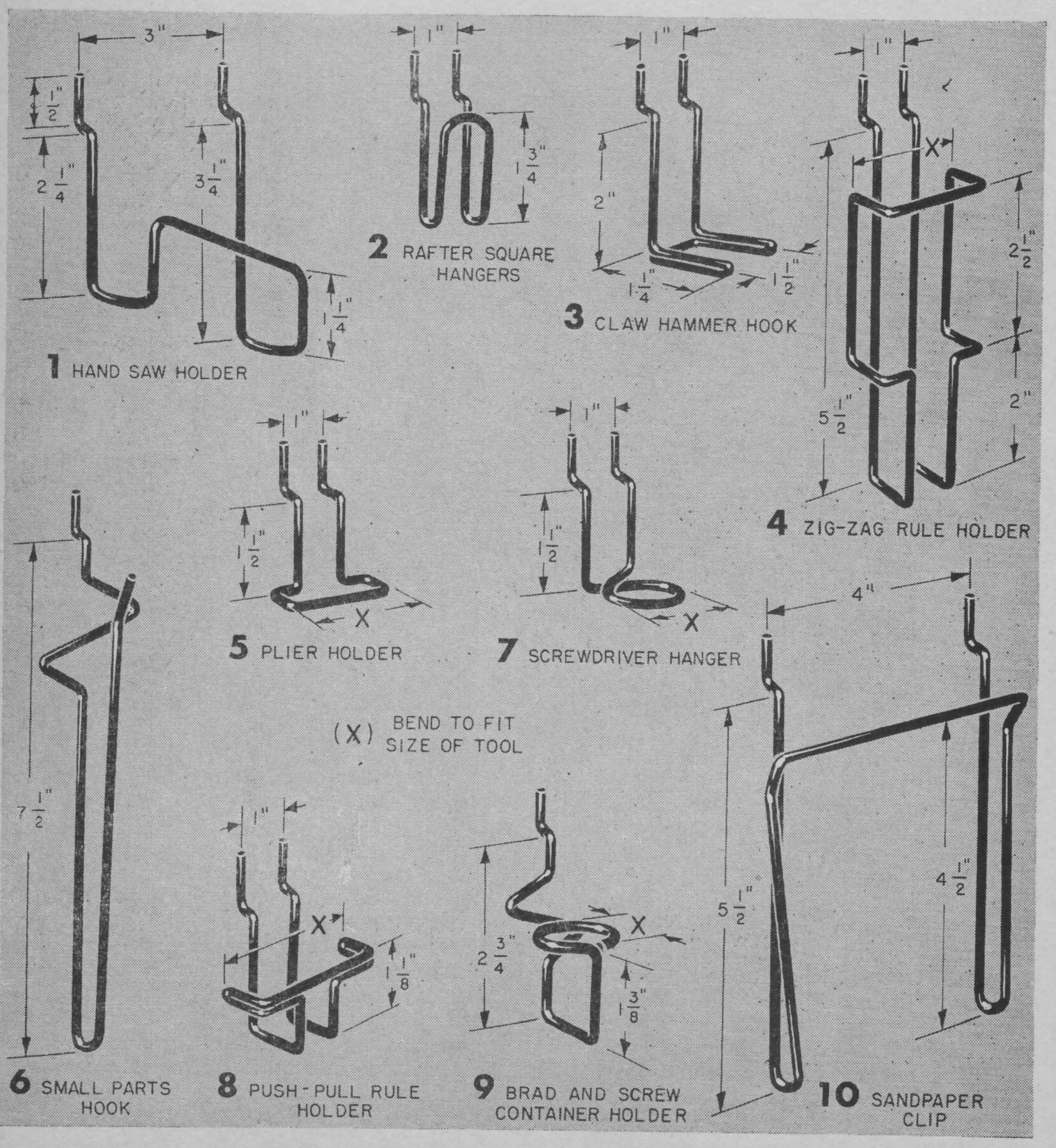
Size all plywood to be painted with *Firzite*. When dry, sand with a hard block backing, and—if necessary—reduce high, hard grain with a cabinet scraper. Then paint or enamel to match your basic kitchen scheme. If desired, a toeboard of plastic can be cemented to the base. These strips are available in black and numerous colors.

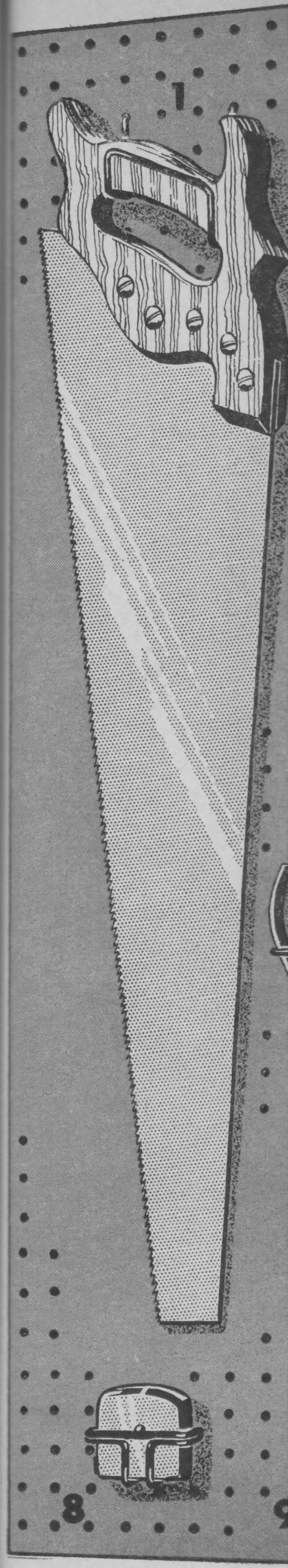
10 Special Uses...

for Old Coathangers

Pliers and a few coathangers are all you need to make these peg-board hangers for those difficult-to-hang tools for which you cannot buy ready-made hooks

By Art Youngquist





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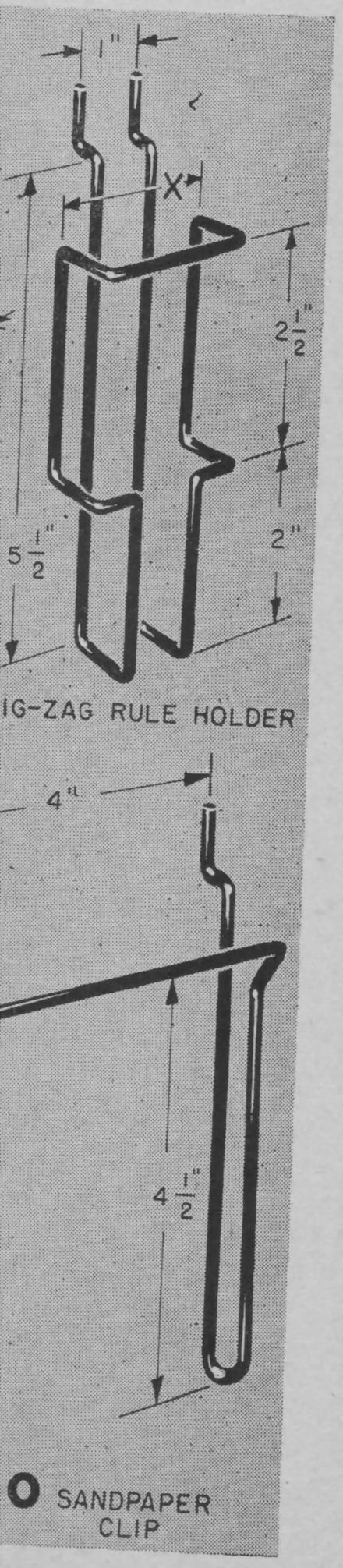
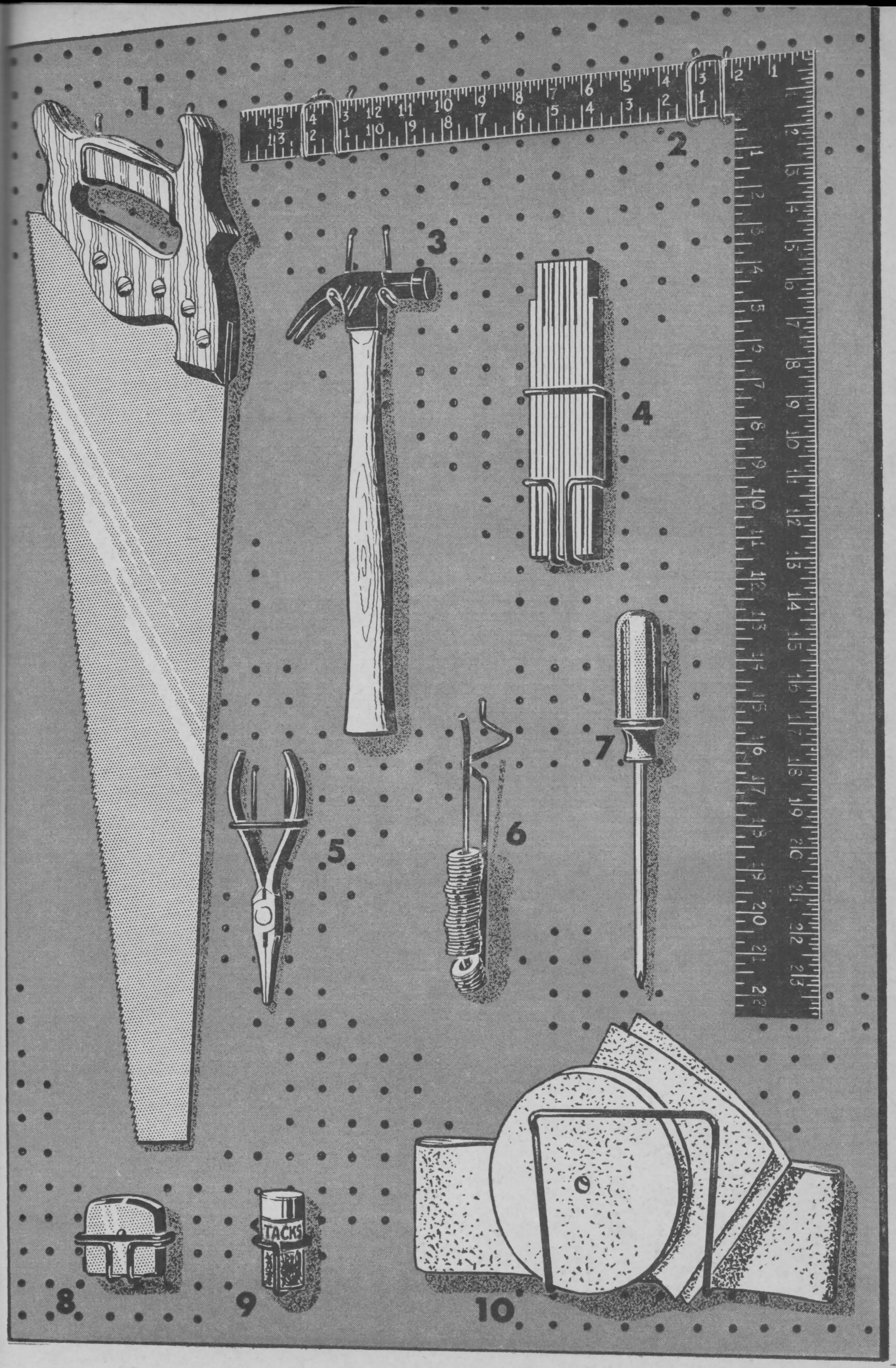
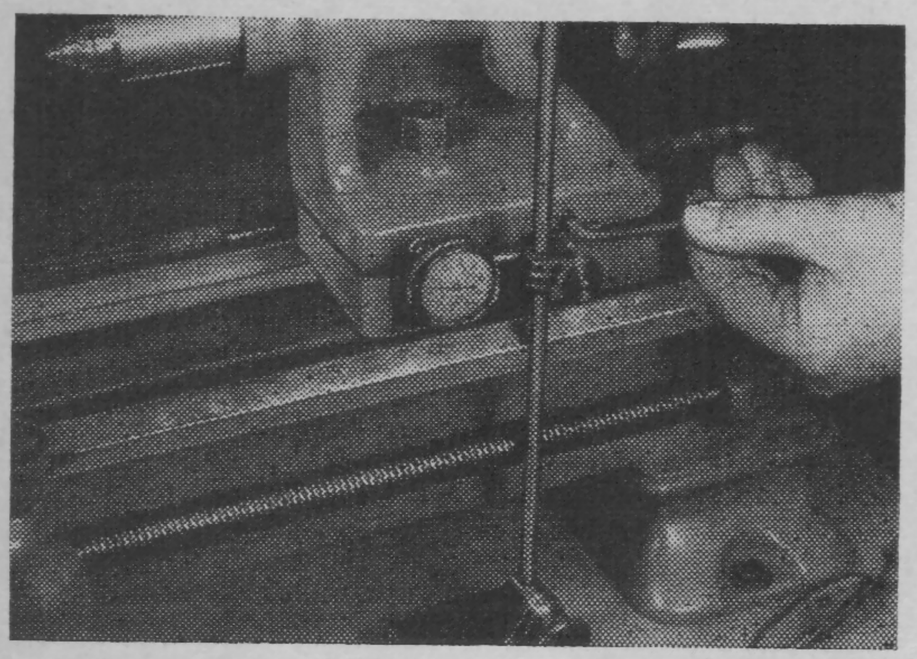




SHOP KINKS

Gaging Tailstock Set-Over

• When you offset your lathe tailstock for taper work, use this method for making a

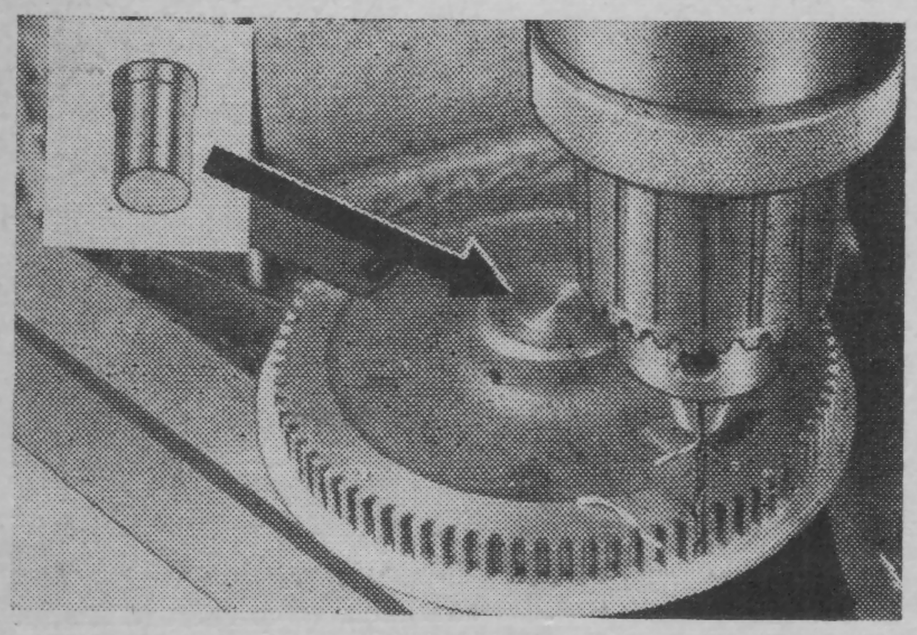


precise set-over quickly. Set up a dial indicator as shown, and it will indicate tailstock movement directly in thousandths of an inch. Mount the indicator on a surface gage, or use a clamp to prevent slippage.—H. J. GERBER.

Gears Space Radial Holes

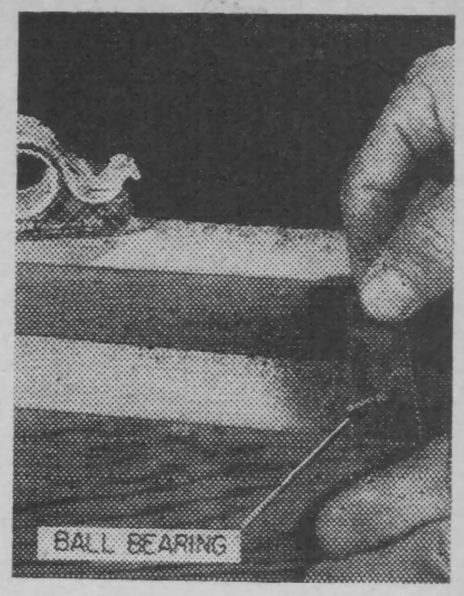
• A lathe gear makes an excellent emergency drill press jig for spacing radially divided holes. Note how the 80-tooth spur gear is used to locate 20 holes in an aluminum disc. The small drill which just fits is nested between every fourth tooth space around the circumference of the spur gear. If you make sure the drill contacts the sides of the gear teeth closely, you'll get precise results. The drill won't damage the gear, since the cutting edges are on the point only.

To insure concentric drilled holes, make a plug which fits tightly through the center hole of the lathe gear and the work piece, and clamp both tightly together. Change gears from a small lathe will give you a wide range of diameters and tooth spacings.— H. J. GERBER.



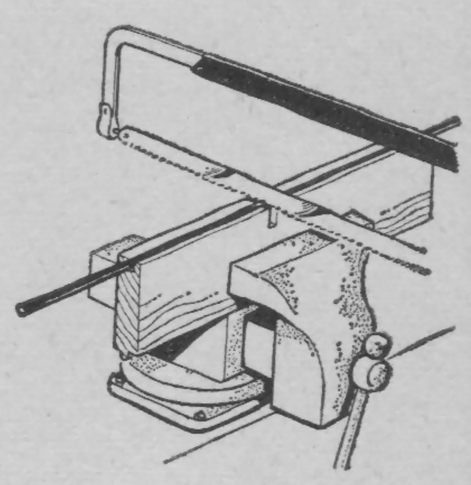
BB Matches Dowel Holes

• To mark two pieces of wood for exactly matching dowel holes, tape a BB to one in the desired place. Then hold the two pieces together in alignment and tap with a mallet. A slight depression mark on each piece of wood will indicate the precise location for drilling dowel holes.—BARBARA LANG.



Grooved Lumber Holds Rods

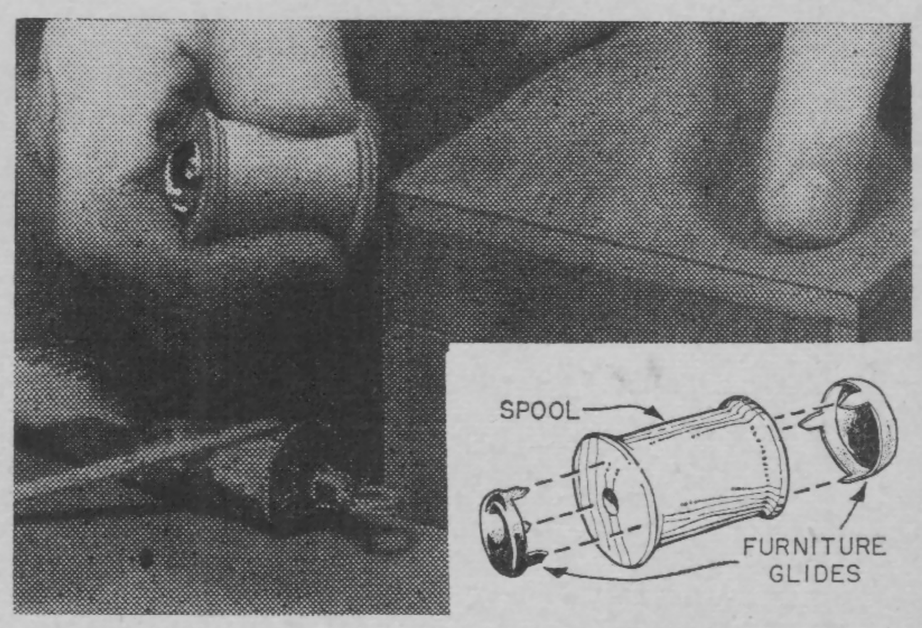
• Place a piece of tongue and groove lumber in your vise to hold the work when you are hacksawing small rods and tubing. You can save the time it would take to clamp each piece, and marks from vise jaws are eliminated.



A slot sawed in the edge of the groove will guide the blade vertically (or even at an angle) enabling you to cut duplicate pieces accurately.—G. E. HENDRICKSON.

Spool Makes Smoothing Tool

• Drive two common furniture glides into the ends of a spool to make this handy desk and workbench tool. Preferably one glide should be larger than the other. The smooth dome-shaped metal surfaces are ideal for



rubbing glued joints into good contact, and for smoothing rough spots on metal, lacquer, and plastics. In your darkroom, use it for pressing edges of prints into contact with ferrotype plates. At your desk, use it to make sharp creases in thin papers, and to smooth paper after erasing.—W. E. BURTON.

Magnet H

• Instead of picking tainers one at a time common horseshoe m one from an old radi holds brads ready for the bench, and tends fingers. Also, when brad bins, use the m while blowing or bru HENDRICKSON.

Driving Brads

• You can drive bra side corners of boxes holder made of tubi Get an old ball-point 2 in. of the hollow m

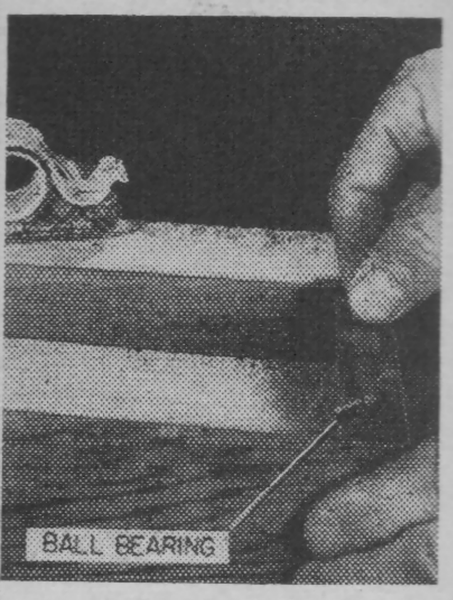
as its ink reservoir. inside with a pipe cl gine," or any similar (Work carefully since to remove from the f

Then, make the bra the point of a finis holder, place it at th a brad which slides drive it home with th HEGEMEYER.

Hacksaw Renew

• After a hammer has pulled quite a few nails, the slot between the claws often becomes so badly worn that the heads of small nails can slip right through. To restore the hammer's pull, just hacksaw the slot a little deeper as shown.—JOHN A. C

Dowel Holes



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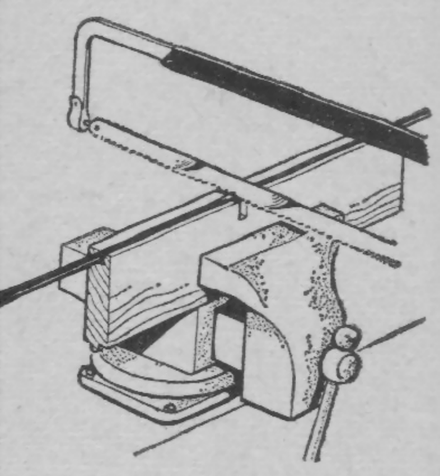

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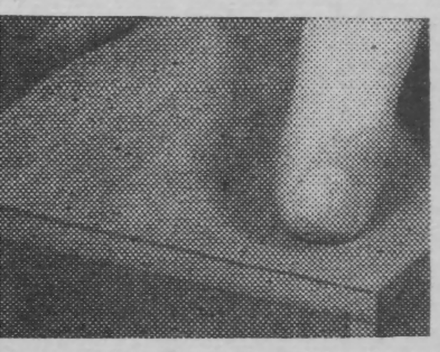

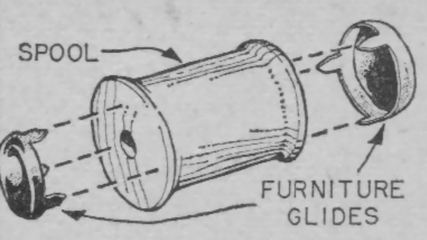

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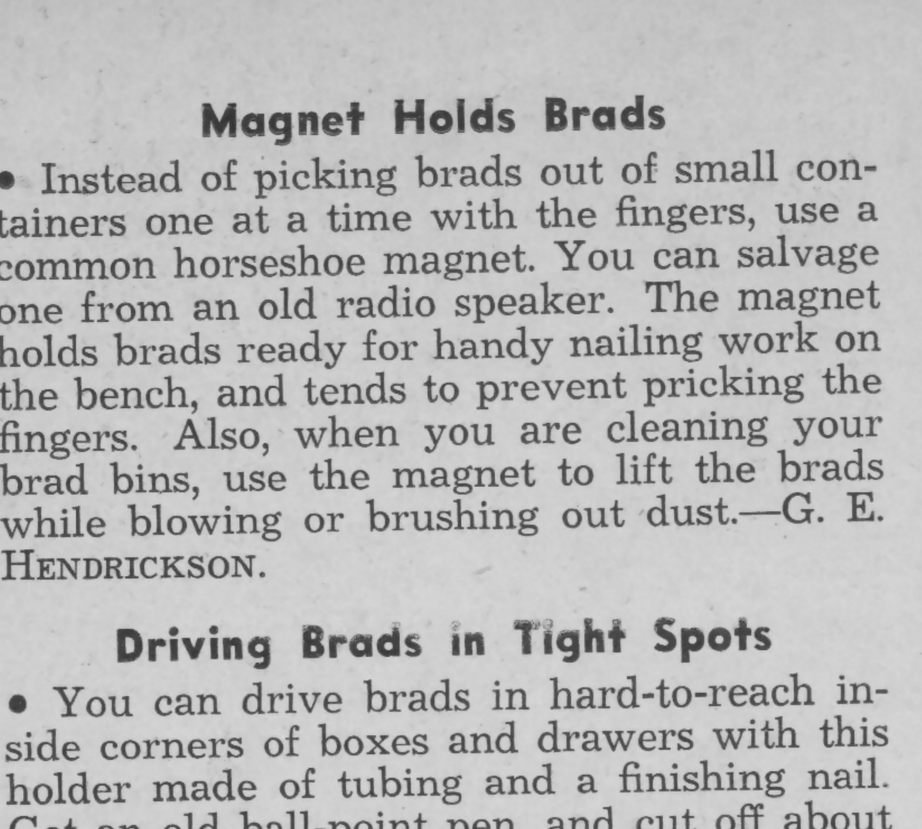
Magnet Holds Brads

• Instead of picking brads out of small containers one at a time with the fingers, use a common horseshoe magnet. You can salvage one from an old radio speaker. The magnet holds brads ready for handy nailing work on the bench, and tends to prevent pricking the fingers. Also, when you are cleaning your brad bins, use the magnet to lift the brads while blowing or brushing out dust.—G. E. HENDRICKSON.

Driving Brads in Tight Spots

• You can drive brads in hard-to-reach inside corners of boxes and drawers with this holder made of tubing and a finishing nail. Get an old ball-point pen, and cut off about 2 in. of the hollow metal center which serves

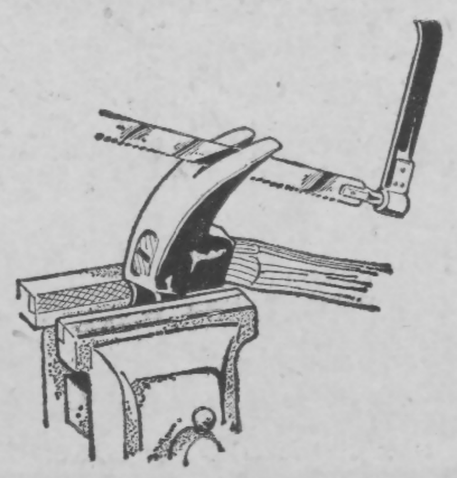


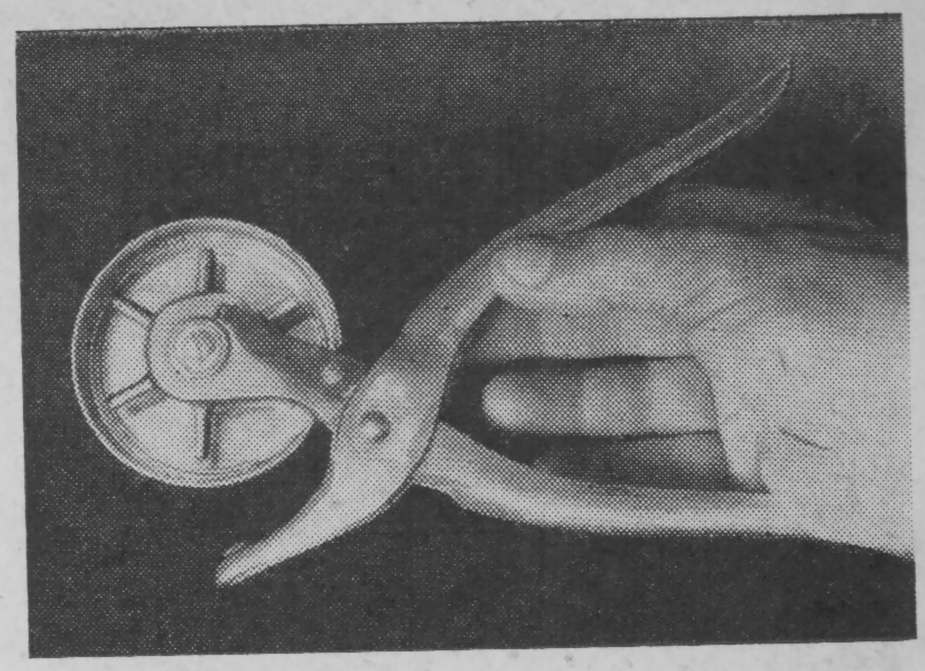
as its ink reservoir. Clean the ink from the inside with a pipe cleaner dipped in "Energine," or any similar household spot remover. (Work carefully since the ink is very difficult to remove from the fingers.)

Then, make the brad driver by grinding off the point of a finishing nail. To use the holder, place it at the desired spot; drop in a brad which slides freely in the tube, and drive it home with the brad driver.—FRANK HEGEMEYER.

Hacksaw Renews Hammer's Claw

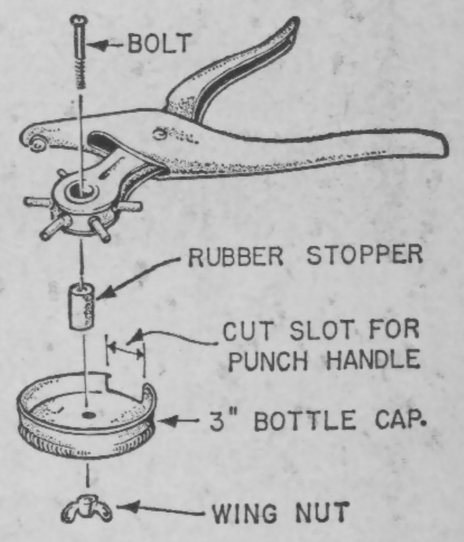
• After a hammer has pulled quite a few nails, the slot between the claws often becomes so badly worn that the heads of small nails can slip right through. To restore the hammer's pull, just hacksaw the slot a little deeper as shown.—JOHN A. COMSTOCK.





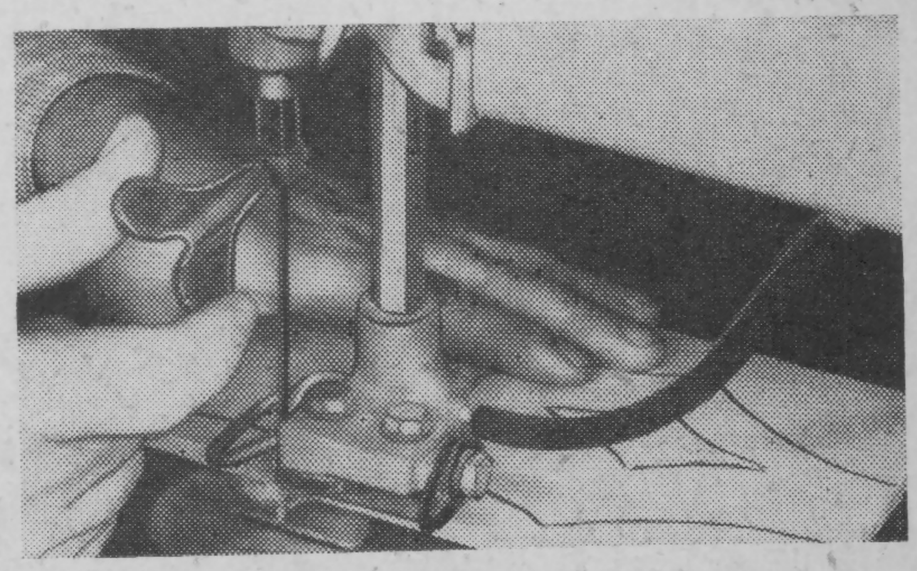
Capping the Punch

• With this cover made from a 3-in. bottle cap, you can protect the easily nicked cutting edges of your leather punch. Cut a slot in the side wall of the cap for the handle, and drill a hole in the center for the bolt. This bolt and wing nut hold a rubber stopper which just fits snugly into the center hole of the turret. With the wing nut loose, the rubber portion slips through the hole easily. Tighten the nut a few turns, and the rubber will expand, holding your shield firmly in place.—A. ZANELLI.



Spoke Key Tightens Saw Chucks

• If your scroll saw has small thumb screws on the upper and lower chucks, you may find that the blades often work loose, because it is difficult to tighten the screws sufficiently by



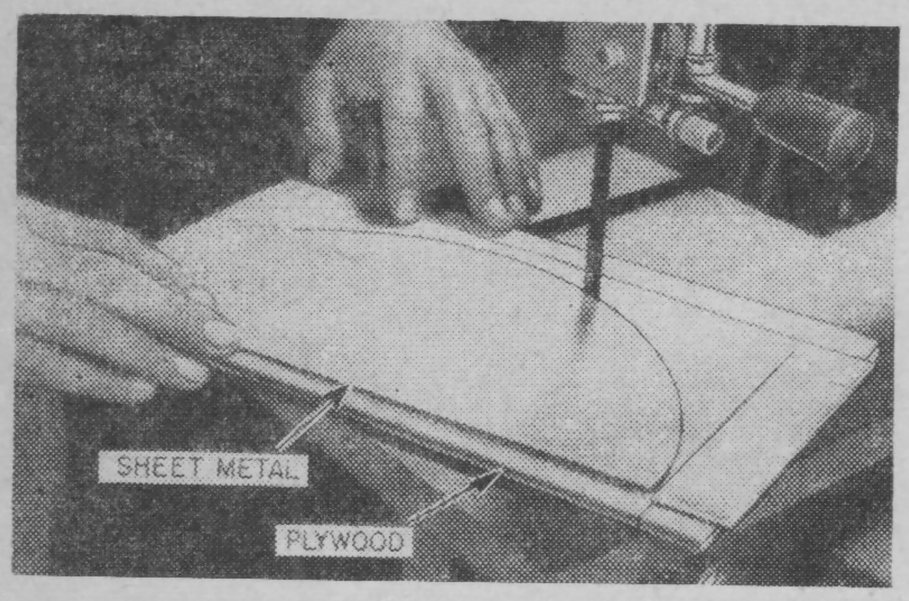
hand. An ordinary bike wheel spoke key provides the right leverage to hold the blades securely. Drill a hole in the key and you can attach it to your machine with a cord, to keep it handy.

Do not tighten the thumb screws so much that they will strip the threads. Just a light extra turn will do it.—FRANK HEGEMEYER.

SHOP KINKS

Sawing Thin Sheet Metal

• When you saw thin sheet metal on your jig saw, or band saw, avoid ragged edges and broken blades by resting the metal on some



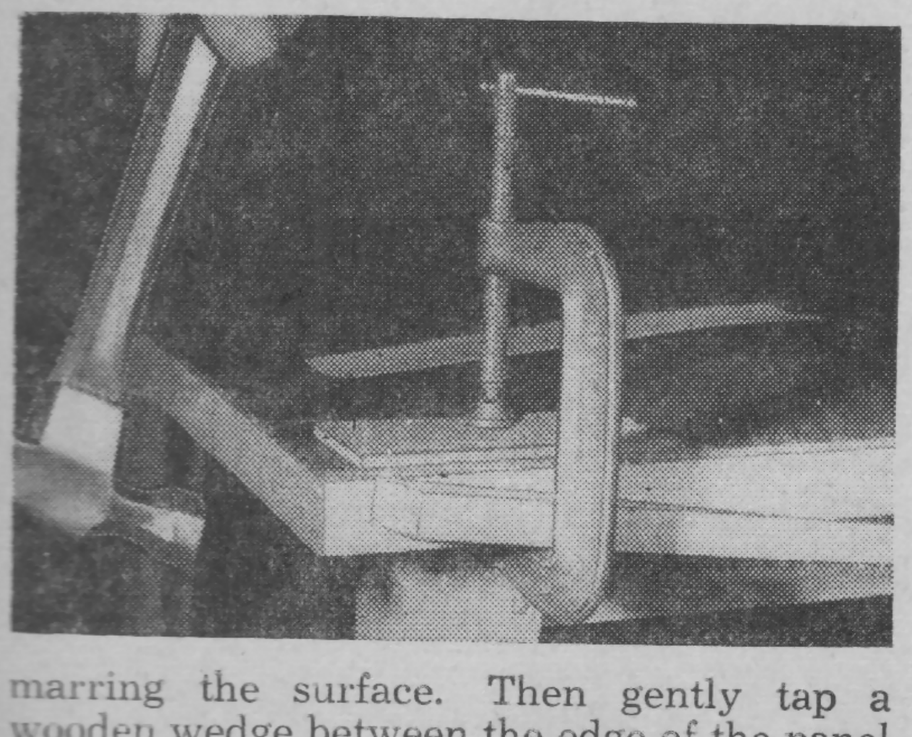
scrap plywood. If there is considerable work to be done, secure the metal in place with rubber cement or double-faced adhesive tape. —R. J. DeCristoforo.

TSP Cleans Clogged Wood Rasp

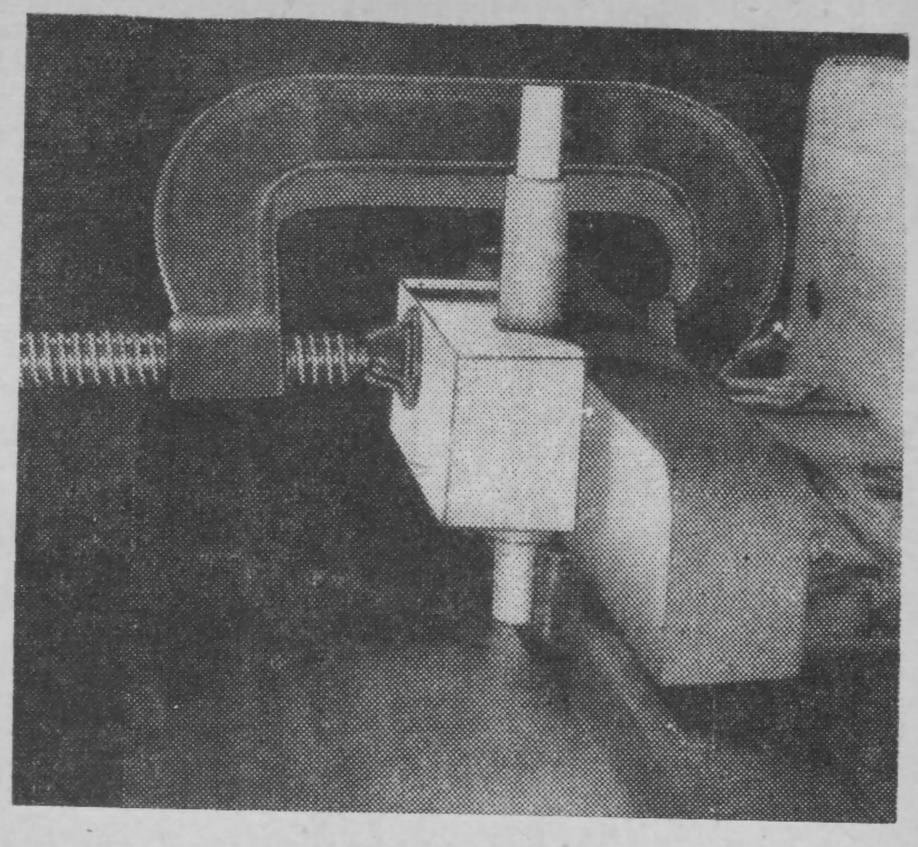
• When you remove paint from surfaces, such as window sashes, the teeth of a wood rasp become clogged. Clean the rasp by boiling five minutes in a strong solution of trisodium phosphate, (hardware and paint stores sell it). This solution softens and loosens the paint, allowing you to easily remove the particles from the teeth with a file brush or old tooth brush.—Andrew Vena.

Curing Veneer Gaposis

• When you veneer the edge of a panel, or table top, you may find a small area where the glue does not stick. Clamp the panel as shown, using scrap hardboard to prevent



marring the surface. Then gently tap a wooden wedge between the edge of the panel and the clamp to maintain pressure on the veneer until the glue is well set.—D. S.

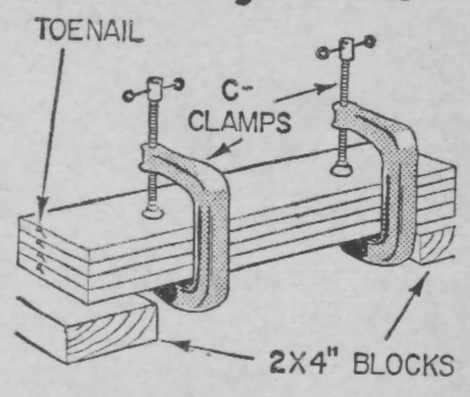


Dowel Tenoning Jig

• With this jig, you can reduce the diameter of dowels quickly and accurately, on your jointer. Simply cut a slot in a small block of wood equal to the diameter of the dowel. Clamp the block to the jointer, and insert the dowel through the slot, rotating it slowly as the cutterhead turns. The length of the tenon formed is controlled by the location of the jointer fence.—R. J. DeCristoforo.

Making Laminated Carving Blocks

• When a thickness of 3 in. or more is required in a carving block it is best to use a laminated block which will resist warping and especially the checking and splitting resulting with solid "logs." Make up such a block of ¾- to 1-in. lumber of any desired width and length (usually 6 to 12 in. wide and 3 to 6 ft. long). Glue flat, clean mating surfaces together with *Weldwood* cold setting resin glue until block is built up to desired height. Toenail at least one nail in each end of each board to tie block together and prevent slippage when clamping up.



Use 2 x 4 blocks under each end of bottom board to allow clearance for C-clamps which clamp the laminations together. Use plenty of pressure. Scrap lumber between clamps and block will prevent marring block surfaces. Wipe off excess glue with a damp cloth. Spread newspapers under the job to catch glue drippings. Store block in a fairly dry, warm place; after 12 hours trim the ends on a bandsaw and apply one or two coats of shellac to the ends.

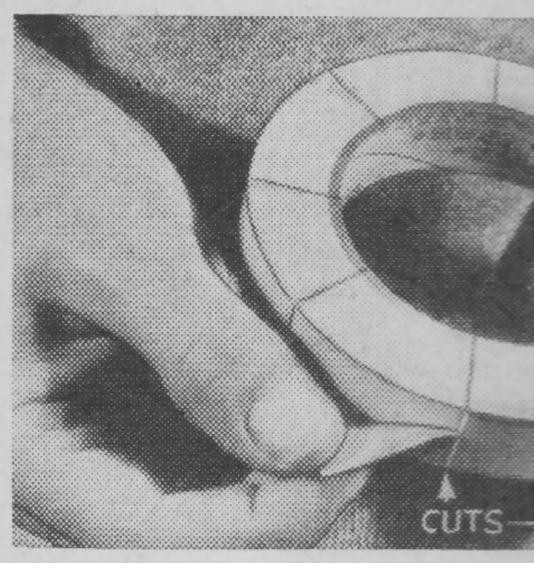
By gluing up a log you'll have a ready source of any size blocks which may be simply bandsawed off.

Magnetic Razor Bl

• A razor blade on the radio-TV bench is essential for trimming, and stripping insulation, but it can cause nicked fingers. Use a magnet from an old ion trap, or PM speaker, fast or wire, to make this tool-l less chance of cut hands, t right where you can find it A. Comstock.

Pre-Cut Tap

• Draftsmen and other w frequent use for small piec it faster and more conven tire roll of tape to size at



make radial cuts with a ra sharp knife. Small pieces job, are then easily remov

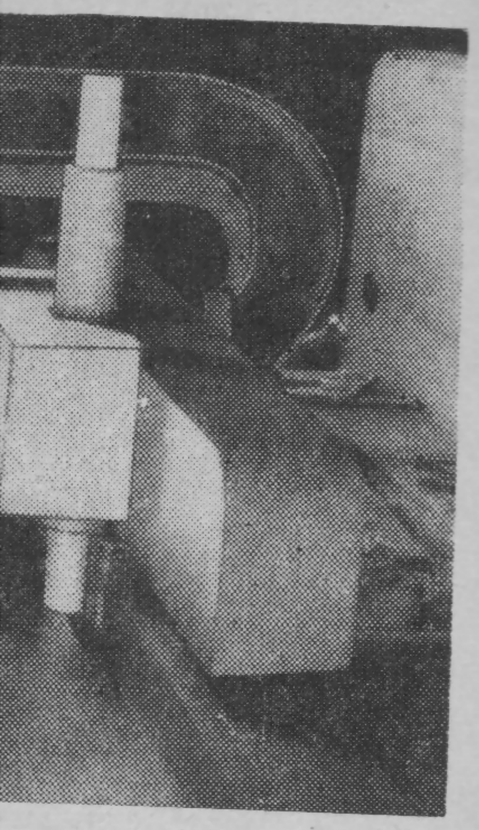
Formula for Cleaning O

• If you are plagued by a shop or garage floor, try product developed espec dishwashing. Called *Cal* pound is formulated to cu vent scum and film.

First, sweep the floor cle and blot excess oil and board or old rags. For extr especially those with slic 6 oz. of the compound in (100° F.) water, using a w moderately stained garage do the job. *Do not let the contact with skin or eyes.*

Use a long-handled brush with solution. Since the w agents have a tendency to pery, rinse floor thorough with a hose.

This extra-strong concen able for cleaning greasy t rubber mats, whereas norm quire only one tablespoon water.



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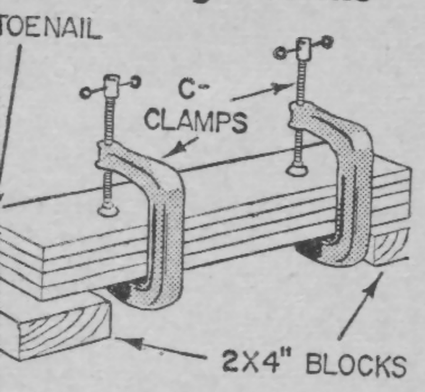

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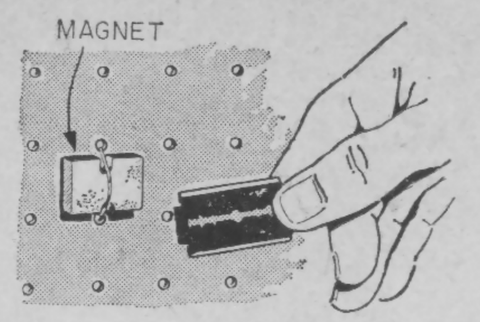
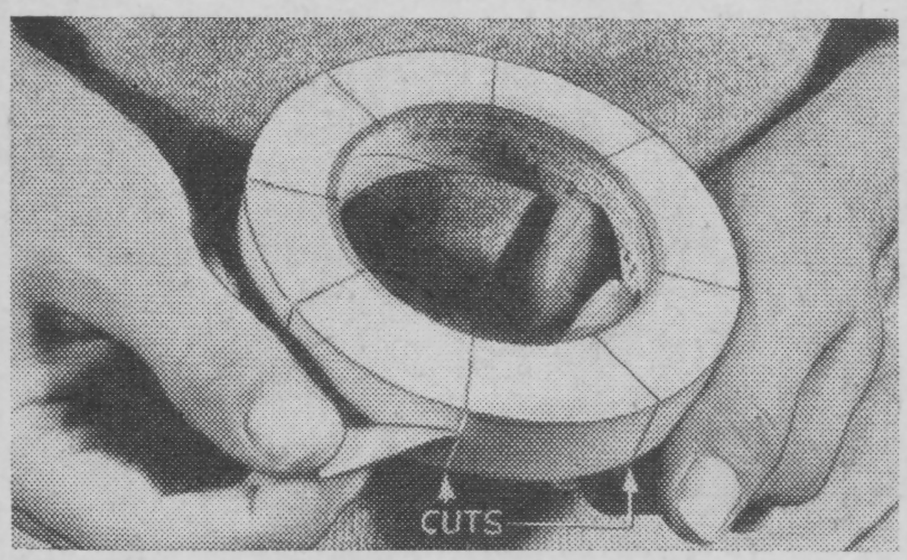
Magnetic Razor Blade Keeper



• A razor blade on the radio-TV bench is essential for trimming, and stripping insulation, but it can cause nicked fingers. Use a magnet from an old ion trap, or PM speaker, fastened with screws or wire, to make this tool-board holder. With less chance of cut hands, the blade is always right where you can find it in a hurry.—JOHN A. COMSTOCK.

Pre-Cut Tape Roll

• Draftsmen and other workers who have frequent use for small pieces of tape will find it faster and more convenient to cut an entire roll of tape to size at one time. Simply



make radial cuts with a razor blade or very sharp knife. Small pieces, suitable for the job, are then easily removed.—R. J. D.

Formula for Cleaning Oil-Soaked Floors

• If you are plagued by a greasy, oil-stained shop or garage floor, try cleaning it with a product developed especially for electric dishwashing. Called *Calgonite,* the compound is formulated to cut grease and prevent scum and film.

First, sweep the floor clean of all loose dirt, and blot excess oil and grease with cardboard or old rags. For extremely dirty floors, especially those with slick stains, dissolve 6 oz. of the compound in 1 gal. lukewarm (100° F.) water, using a wooden stirrer. For moderately stained garage floors 4 oz. should do the job. *Do not let the solution come in contact with skin or eyes.*

Use a long-handled brush for cleaning floor with solution. Since the water conditioning agents have a tendency to make floors slippery, rinse floor thoroughly after cleaning with a hose.

This extra-strong concentration is also suitable for cleaning greasy tile, concrete, and rubber mats, whereas normal applications require only one tablespoonful to a gallon of water.

Non-Tipping Oil Can

• The type of oil can seen here has one serious fault; being top-heavy, it tips over easily. You can cure the oil can of this failing and reduce the resultant mess by soldering it to the cover of a small can.—M. A. TIDD.

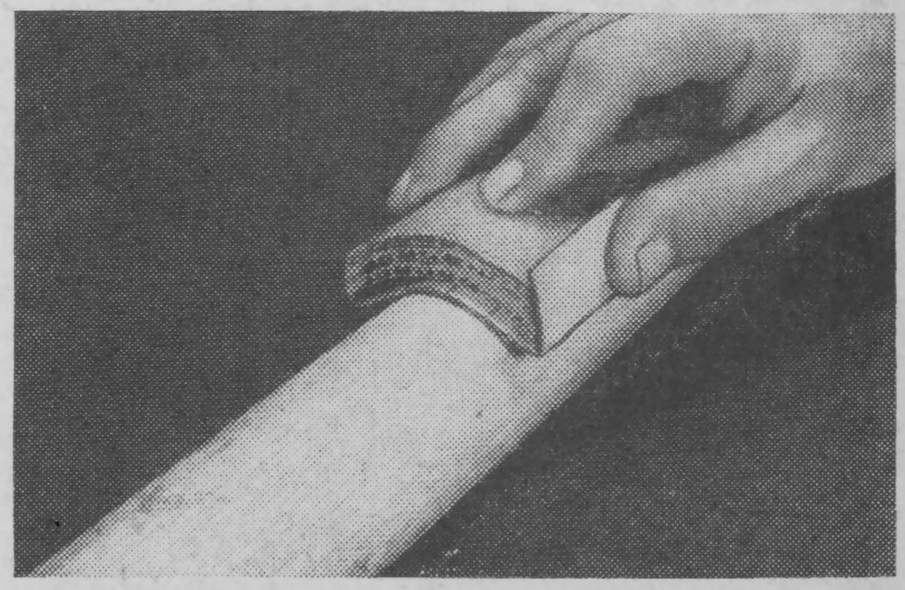
Double-Sided Tapes Simplify Duplicate Sawing and Drilling

• For sawing or drilling a stack of flat duplicate wood or metal parts, use a thin double-surfaced adhesive tape for temporary fastening. This eliminates marking the pieces with nail and screw holes. And it will be easier to handle stacked work, without the usual clamp in the way on your power tool table.

Use only enough tape to hold your work pieces securely together. Smooth clean surfaces require less tape than coarse or porous materials. An adhesive in tape form is a new product offered by Kleen-Stick, 7300 W. Wilson, Chicago 31, Ill.—J. C. ROBY.

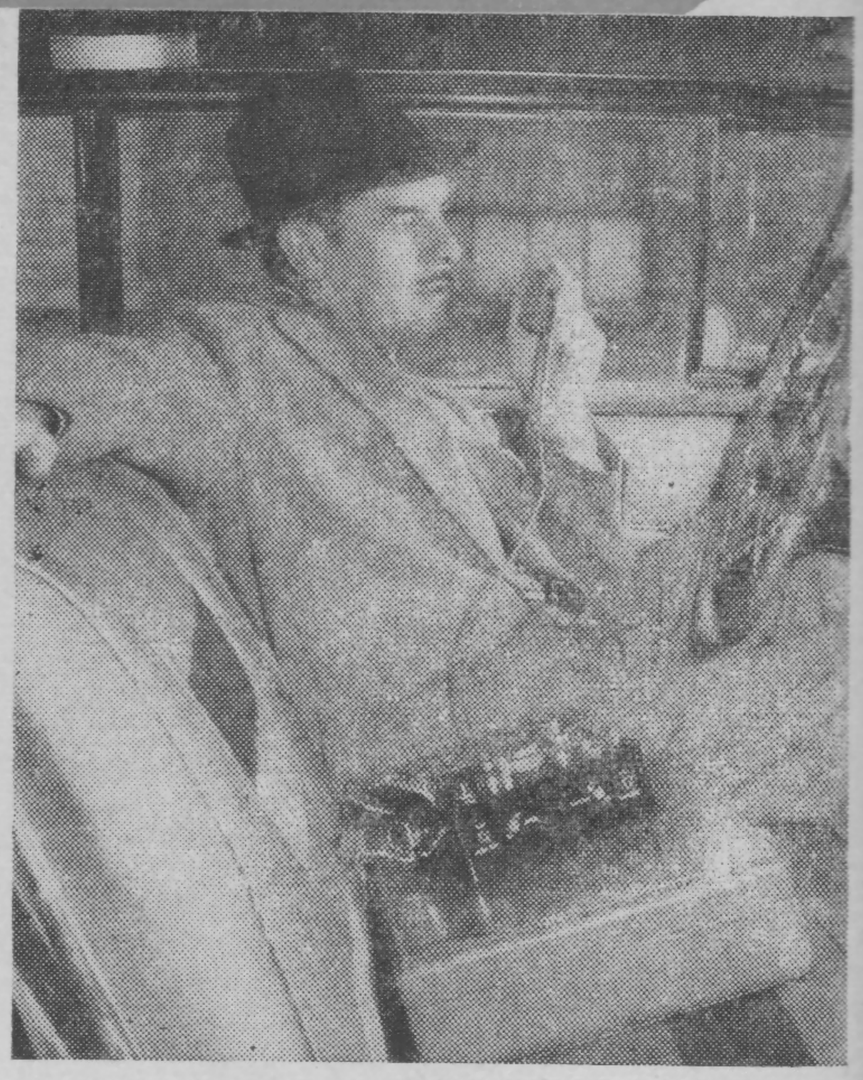
Sandpapering Curved Work

• For sanding curved surfaces quickly use strips of sandpaper cut about 5 inches wide



and make a holder of several layers of one-sided flexible corrugated board. The more irregular the contour, the thinner the pad should be. For heavy-duty use, make the pad of sheet rubber.—R. J. DECRISTOFORO.

Bonus Blueprint No. 2



Instant-Action

Portable Tape Recorder

WHEREVER you may be, just flick the mike switch and this battery-powered, 4-lb. midget starts recording immediately.

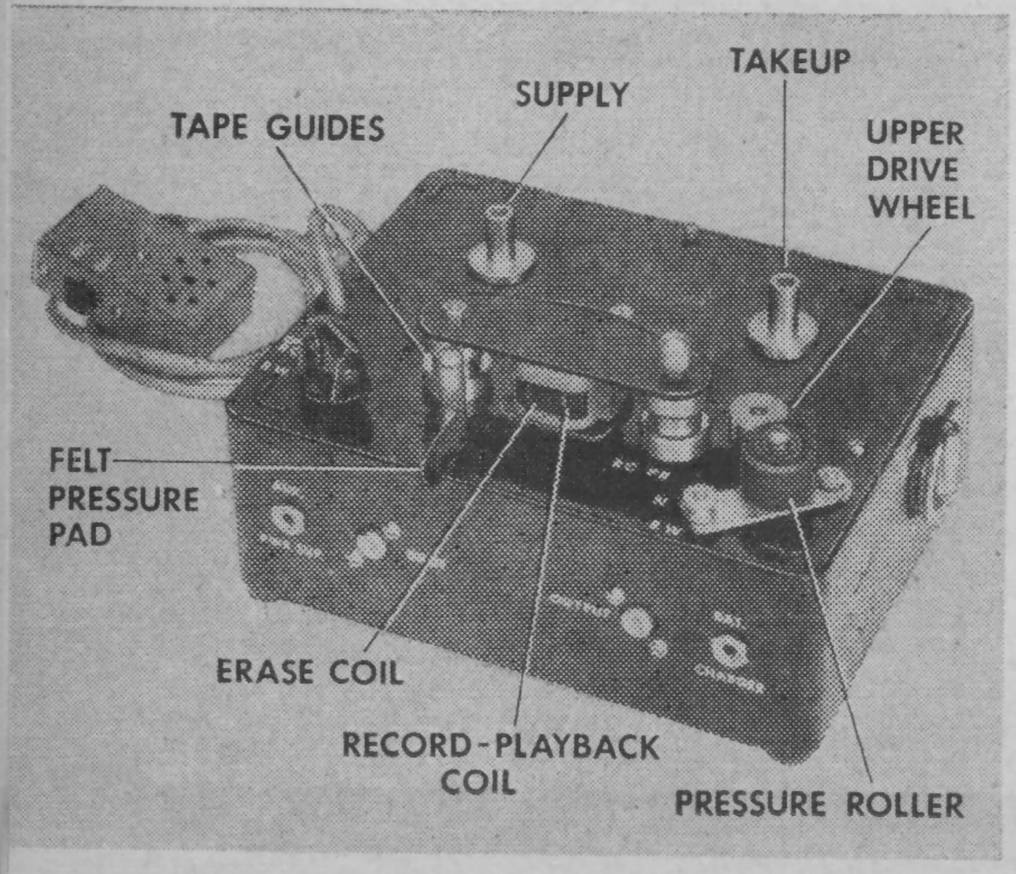
There's no waiting for tube warm-up and no searching around for an electrical outlet with this recorder, which was developed especially for SCIENCE AND MECHANICS magazine by electronics designer James E. Pugh Jr.

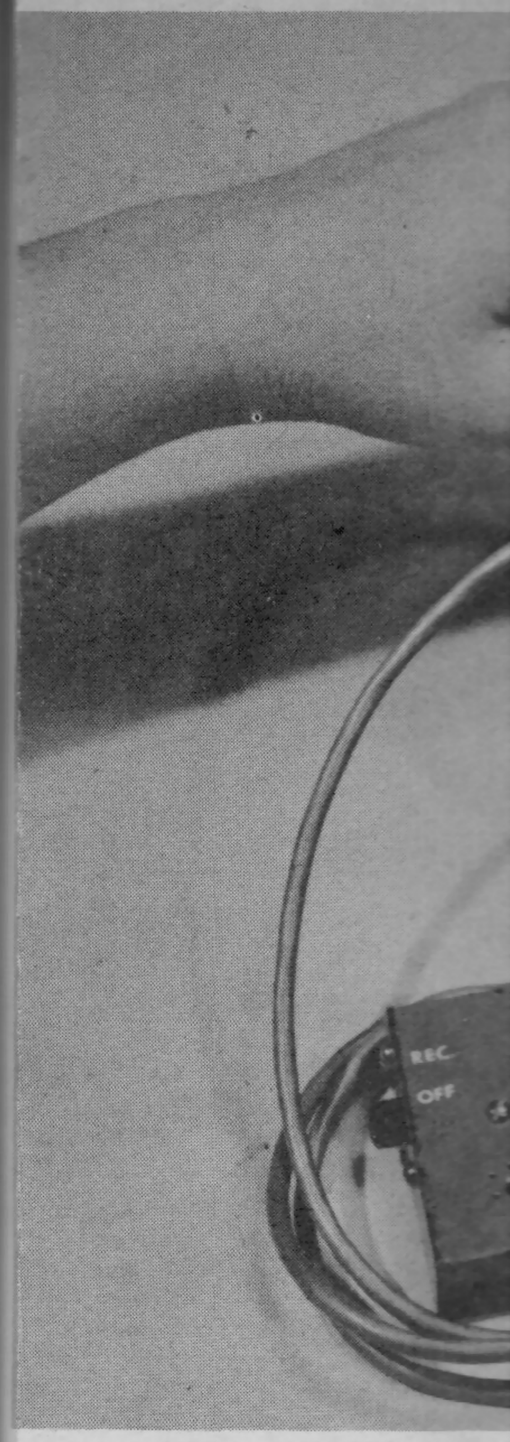
Since the playback speed is the standard 3¾-*ips* used on home recorders, you can play your tapes with loudspeaker volume through a radio or hi-fi unit, instead of the combination mike-speaker with the recorder. A built-in jack plug input also permits you to record voice or music directly from your radio or TV.

Standard flashlight batteries or the new D-size rechargeable storage batteries may be used. The motor-driven fast rewind and erase features of this recorder make it possible to use the same tape over and over.

If enough of you drop us a card requesting us to publish them, we can provide plans in the next issue for a combination battery charger and *ac* power supply which can be used with this recorder. It would save your batteries for outdoor use.

In the meantime, we'd like to make the same offer on this recorder we've made on the other bonus blueprint project in this issue —a $25 prize to the first reader who builds the recorder and sends us a photo of the completed project in action. The postmark on the letter enclosing the photo will determine the winner.





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using a square to
metal is vertical to

When bending,
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1/16-in. center dril
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Locate the holes
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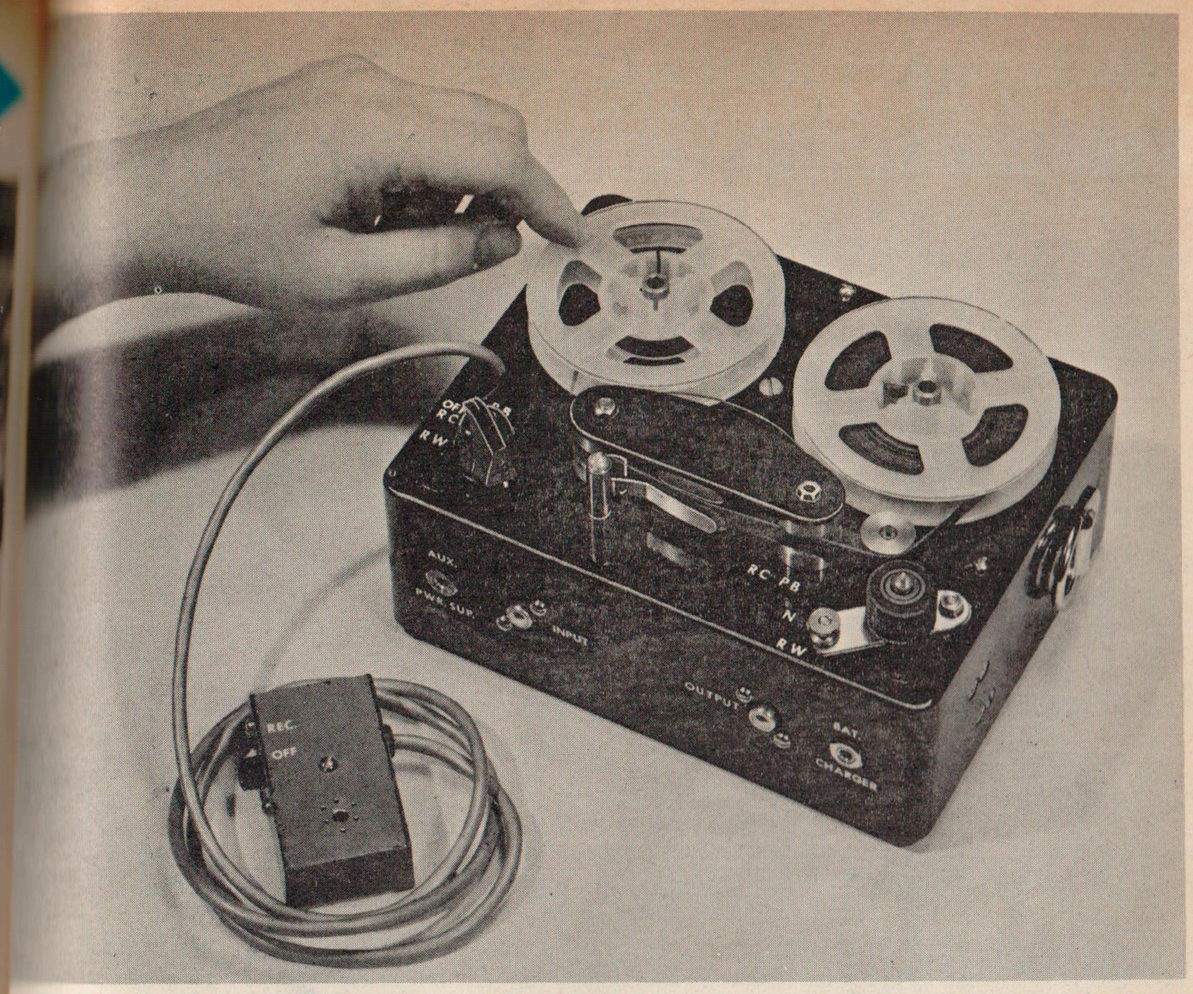


Tear Along Perforated Line

SCIENCE and MECHANICS

Battery-Powered

Transistorized TAPE RECORDER

Construction of this unique, instant recording miniature recorder starts with the metal parts detailed in Fig. 6. First scribe lines at the desired points for cuts and saw and then clamp in a vise along the line, using a square to make sure that the metal is vertical to the vise jaws.

When bending, hammer the part gently, working slowly to make the corners dead square. Next, lay out the hole locations with scriber and center punch and, with the part held firmly in a drill press vise, start the holes with a 1/16-in. center drill chucked in a drill press. Use oil and finish the holes to size with sharp drills. File the three notches in the forward-reverse idler lever, but leave the center notch slightly shallow, since it must be deepened as described later.

Locate the holes in the plastic case with a machinist square and scriber as in Fig. 7, and when drilling, back up the plastic with a wooden block to prevent chipping. When drilling the holes for the two tape spindles, use the metal bracket that goes inside the case as a template to assure matching center-to-center spacing. Countersink each hole requiring a Nyliner bushing inside the case and enlarge them with a tapered hand reamer just enough to obtain a free-turning fit with the shaft when bushing is installed. Each shaft must spin freely in its bushing for smooth tape motion, but cannot be so loose that it wobbles. Nyliner bushings are split at one side to facilitate this kind of adjustment. Insert them by pressing the lower pointed end of the bushing inward and spiraling clockwise into the hole with your fingers, working from the outside of the case, so the broad flange will be on top.

The next stop is to make up the tape drive parts shown in Fig. 8. The three idler wheels must turn freely on their shafts. Mount the forward and rewind idler lever as in Fig. 9. Tighten the screw on the threaded shaft until the compression washer holds the shaft firmly, but not locked in place. Then, holding the first lock nut with a thin wrench to keep the shaft from turning, tighten the second lock nut. It should now be possible to slide the idler along the length of its slot without rocking from side to side.

After all tape drive parts are made and rotating parts operating smoothly, carefully remove the Nyliner bushings and clean all parts thoroughly. Then replace the bushings and coat the inner and flange surfaces with light machine oil.

Adjustment. Put the various shafts and wheels in place (Fig. 9) and tighten the wheel set screws allowing .001-.002 in. clearance between wheel and bushing flange. Also, oil the idler shafts and adjust as described above, making sure that no oil gets on the rubber wheels nor on the metal friction surfaces.

With all of the tape transport parts fastened in place, place the lower function lever in the notch nearest the drive shaft. Press the rubber pressure roller firmly against the upper drive wheel and tighten the set screw. Next, adjust the spiral washer at the notch nearest the drive shaft until the takeup hub rotates when the drive shaft is turned, but when a light pressure is applied to the takeup hub the idler wheel slips. This allows the takeup reel to wind up all slack take but prevents it from pulling the tape through the drive mechanism. Now connect the motors with temporary leads to the battery for testing.

The rewind idler is adjusted by setting the function lever to the outer position and adjusting the outer spiral washer until the rewind motor turns the rewind shaft at just below its highest speed. At this point the slippage should be very small but the pressure should not be great enough to retard the motor speed excessively. Now set the function lever to the Neutral (center) position and file the center notch in the forward-rewind idler lever until both idler wheels are free from the other wheels and both takeup and rewind shafts turn freely. Cover the idler wheels and clean this part carefully each time it is filed to prevent filings from getting on the wheels and inside the case.

To set the record motor tension, fasten the lower drive wheel surface about ⅜" above the lower bearing hanger. Adjust the motor spring tension lever until the drive wheel can be rotated but a noticeable drag from the motor is felt. Too light a tension will allow slippage between motor and tape drive shaft, and too heavy a tension will cause pressure marks in the rubber rim of the drive wheel. The record motor speed is adjusted with a small screw through a hole in the motor case, turning clockwise for more speed. When the upper drive wheel rotates at 120 RPM, the tape will move at 3¾ inches per second.

After these adjustments have been made run the mechanism both forward and reverse for several minutes. Then put the tape reels on and check to see that the tape feeds through the drive smoothly and is not pulled too tightly by the takeup. If at the start, a slight loop is left in the portion of tape between takeup reel and drive wheel it should hold the loop smoothly, gradually becoming smaller as more tape is wound on the takeup reel.

Wiring. Next, wire the amplifier as in Figs. 10 and 11. When soldering transistors, diodes, and electrolytic capacitors hold each lead with long-nosed pliers between the part and the junction being soldered in order to avoid overheating. It is best to solder in resistors first, capacitors next, then diodes and transistors.

Some of the wire in the 4-conductor microphone cable is excellent for wiring as it is small and color coded. Also short sections of the insulation can be removed from this wire for making tiny color coded spaghetti.

After the amplifier is completed, wire the upper section of switch S2 (Fig. 11). Mount it in the case and wire in the tape head, motors, and jacks cutting all wires that connect to the amplifier to the approximate length needed. Now mount the amplifier in place and finish the wiring.

The combination microphone-speaker is housed in a small plastic box, (Fig. 12).

Throw the function switch (S2) to *Playback* (PB) and listen for a weak motor noise in the earphone. Also check to see that both motors rotate in the correct direction. If not, reverse the motor leads. Then adjust the tape pressure pad to hold tape lightly against the tape head. Now you can make a recording. Set the potentiometer R7 about two turns above the full counterclockwise (minimum) position, and the function switch, function lever, and microphone switch to *Record*.

Hold the microphone about 8 in. from your mouth and speak in a normal voice. Play the recording back and adjust the tape pressure pad for maximum volume but be sure that it is not too tight so it drags on the tape. Now make another recording and, if weak, turn the volume control up ½ turn (clockwise) and try again. Repeat until the recording is of a suitable volume but not distorted from overdriving. Minor adjustments can now be made in the tape transport mechanism for smoothest recordings, and the recorder is ready to use.

How it Works. The tape feeds from the supply (left) reel across the first tape guide. From here it passes across the erase coil (on left side of the recording head) and then over the record-playback coil (on the right side of the head). The erase coil thus wipes off any previous recording before it reaches the record coil. The pressure pad holds the tape in intimate contact with the head.

After the tape leaves the recording head it passes between the upper drive wheel and pressure roller and from here to the takeup reel. On playback the erase coil is disconnected by switch (S2) and the recorded signal on the tape energizes the record-playback coil which is now connected to the amplifier input. The amplified signal is fed to the magnetic microphone—now used as an earphone.

A simple three-stage common-emitter amplifier is used. The first two transistors are the PNP and the last the NPN type to allow the mike and record coil return leads to connect directly to common, on both record and playback, without using decoupling filters. High-frequency pre-emphasis is used on *Record* with flat response being used on *Playback* providing better quality with minimum distortion. The transistors are temperature compensated for use under temperature extremes.

Motor noise is removed from the amplifier *dc* power source with V4, which acts as stable voltage regulator. The voltage across the zener diode (D1) is constant at 3.9 volts as long as the input voltage does not fall below this value. Because this diode is in the base circuit, it determines the voltage output level at the emitter of V4. Since the base voltage is constant the output voltage will thus be constant regardless of variations at the input (at V4 collector); therefore, variations due to motor noise will be filtered out.

Battery Notes. You can use either rechargeable Sonotone nickel-cadmium or flashlight cells. If flashlight cells are used the voltage will be 6 volts with 4 cells, while if the nickel-cadmium cells are used 5 volts will be obtained with 4 cells, which is all that fit in the case.

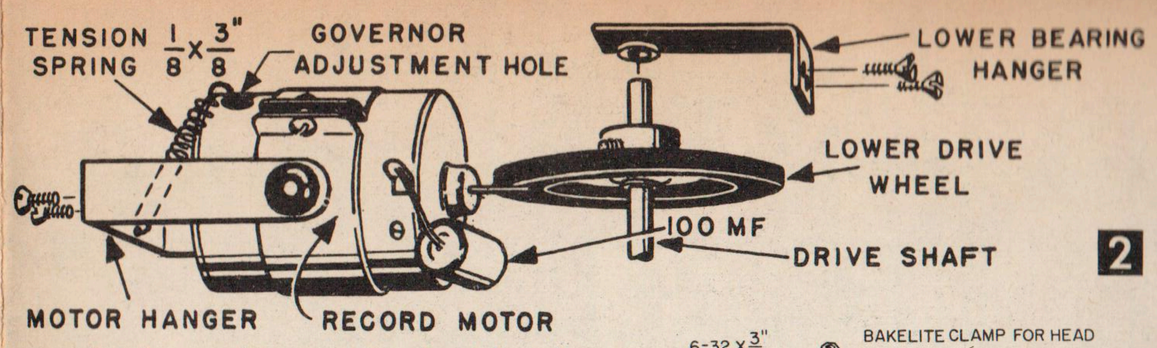
The nickel-cadmium cells provide nearly constant output voltage throughout their charge, whereas the flashlight cells drop off as they are used. Constant voltage is an advantage in maintaining motor speed; however, the 5-volt level approaches the lower limit for best governor operation.

Be very careful to avoid short circuits in your recorder if the S-103D cells are used as they have such a large current capacity that a fire can be started from heated wires.

The nickel-cadmium cells are slightly shorter than flashlight cells and a short 4-40 rh screw is threaded into the positive terminal of each battery clip to compensate for the difference (Fig. 4).

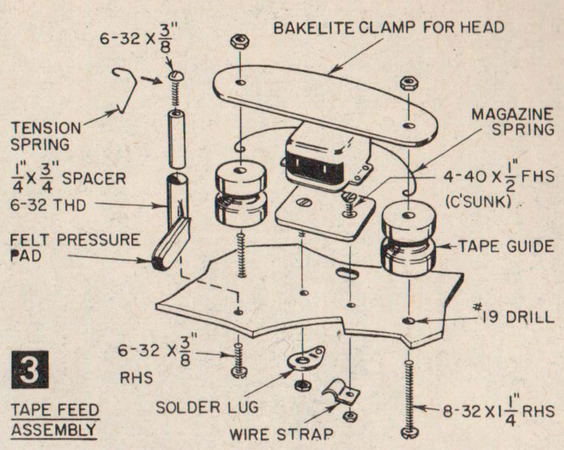
If you use flashlight cells it is advisable to select Eveready Type D99, a leakproof type, to avoid damage to the recorder. Jacks are provided to allow recording an external signal; to feed the amplifier output to an external power amplifier; to connect an external power source such as a 6-volt automobile battery or an auxillary *ac* power supply; and to connect the charger to the batteries. When the external power supply is connected the internal batteries are disconnected, and when the charger is connected the amplifier and motors are disconnected.

Accessories. The tape cartridge (Fig. 5), allows recorder to be carried as a portable unit in any position.



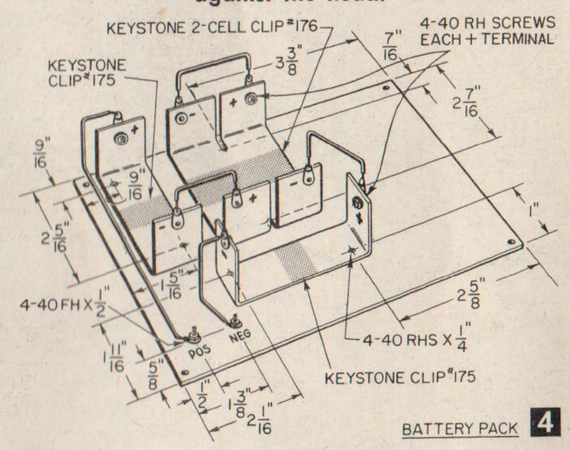
2

Speed of the tape drive motor is reduced through a rubber rim idler wheel. A spring holds the motor shaft in contact.



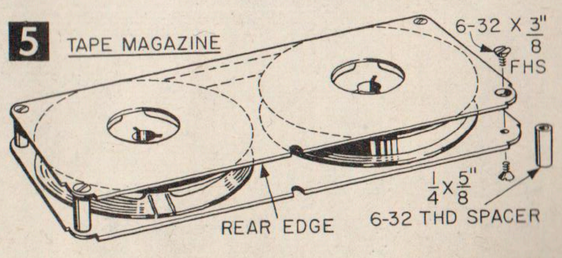
3 TAPE FEED ASSEMBLY

Tape guides guarantee precise tracking of the tape across the recording head. Adjust felt-covered pressure pad so it lightly presses tape against the head.



BATTERY PACK 4

Four rechargeable batteries (or four flashlight-type D-size dry cells) are mounted on the bottom panel.



Details of tape cartridge.

MATERIALS LIST — TAPE RECORDER

No. Req'd	Size and Description
	Tape Drive Mechanism
1	2-5/16 x 5-9/32 x 6-13/16" black plastic case with panel (Allied Radio)
1	2" O.D. takeup idler wheel (Walsco 1433)
1	2" O.D. rewind wheel (Walsco 1433)
1	2" O.D. lower drive wheel (Walsco 1483)
1	1" O.D. rewind idler wheel (Walsco 1450)
1	¾" O.D. pressure roller (Walsco 1458)
1	⅝ x 1½" dia. brass for lower takeup wheel
1	⅞" dia. x 6" brass for hubs, driver wheels and tape guides
1	3/16" dia. x 12" drill rod for reel, drive and idler shafts
1	¼" dia. x 3" drill rod for pressure and function lever shafts, function lever hub
2	3/64 x ½ x 18" precision ground flat stock for hangers and levers
2	spiral tension washers
2	¼" dia. x ¾" 6-32 threaded bushings
3	3/16" I.D. 3L1-FF flanged Nyliners (Thomson Industries, Inc.)
3	3/16" I.D. 3L2-FF flanged Nyliners (Thomson Industries, Inc.)
2	¼" I.D. 4L1-FF flanged Nyliners (Thomson Industries, Inc.)
1	¼" I.D. 4L2-FF flanged Nyliners (Thomson Industries, Inc.)
1	3/16" dia. x ⅝" tension spring (General Cement H420-F assortment)
1	⅛" dia. x ⅜" tension spring (General Cement H420-F assortment)
4	½" dia. rubber feet (General Cement H052-F assortment)
	Amplifier
1	B1 Battery pack consisting of 4 Sonotone rechargeable nickel-cadmium type S-103D batteries; or 4 Eveready Type D99 leakproof flashlight cells
1	M1—6-volt rewind motor (Wilson's of Cleveland model 6-100)
1	M2—6-volt DC record motor (Barber-Colman BYQM 2022) Allied Radio
1	D1—3.9-volt voltage regulator Zener Diode (Texas Instrument 1N748A)
3	V1, V2, V4—2N217 PNP Transistor (RCA)
1	V3—2N647 NPN Transistor (RCA)
1	L1, L2—Record-PB-Erase head (Shure 815H)
1	Magnetic microphone, 1000 ohm (Shure MC11J) Allied Radio
1	S1—SPST slide switch
1	S2—5-pole, 3-position wafer switch (Centralab PA-2015)
	Capacitors
5	C1, C2, C3, C5, C6—2uF, 6-volt ultra-miniature electrolytic capacitors (Barco PT6-2), Lafayette Radio
1	C4—.2uF, 75-volt ceramic capacitor (Lafayette Radio C-616)
2	C7, C9—100uF, 15-volt ultra-miniature electrolytic capacitors (Lafayette CF-126)
1	C8—160uF, 15-volt ultra-miniature electrolytic capacitor (Lafayette Radio CF-127)
	Resistors
3	R1, R4, R6—3.3K, ½-watt, 10% carbon resistors
3	R2, R5, R10—72K, ½-watt, 10% carbon resistors
1	R3—4.7K, ½-watt, 10% carbon resistors
1	R7—5K miniature trimmer potentiometer (Bourns Wirewound Trimit 271)
1	R8—10K, ½-watt, 10% carbon resistor
1	R9—3.3K, ½-watt, 10% carbon resistor
1	R11—150 ohm, ½-watt, 10% carbon resistor
1	R12—1.8K, ½-watt, 10% carbon resistor
	Tape Cartridge
4	¼" x ¾ 6-32 threaded bushings (Newark Electric Co.)
2	2¾ x 6⅜ x 3/32" thick Bakelite sheet
6	.020 dia. piano wire
1	3 inch reel of long play 1 mil tape
1	3 inch empty reel
	Hardware
2	J1, J2—phono pin jacks (RCA)
2	J3, J4—sub-min phone jacks (Switchcraft 42A)
2	battery clips for 1 type-D cell (Keystone 175)
1	battery clip for 2 type-D cell (Keystone 176)
1	¾ x 1⅜ x 2⅜" plastic box for mike and S1
1	3 ft. length, 4-conductor cable (Belden 8444)
21	turret terminals USECO 1350C
1	2 x 2-13/16 x 3/32" Bakelite sheet
12	4-40 x ½" *fh* screws with nuts
4	4-40 x ⅜" *rh* screws with nuts
5	4-40 x ⅜" *rh* screws with nuts
12	6-32 x ⅜" *fh* screws with nuts
1	6-32 x ⅝" *rh* screws with nuts
1	6-32 x 1¼" *rh* screws with nuts
4	6-32 x ½" *rh* screws with nuts
1	6-32 x ½" *fh* screws with nuts
2	8-32 x 1¼" *rh* screws with nuts
2	#6 x ½" dia. washers (for cams)
2	carrying strap brackets
1	shoulder strap (camera stores)
Misc.	lock washers, ⅛" decals, plastic spray, resin core solder

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SCIENCE and MECHANICS

Battery-Powered

Transistorized TAPE RECORDER

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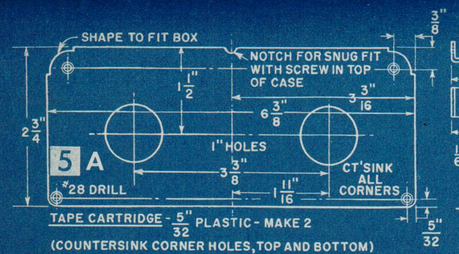
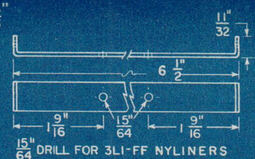


5 A

TAPE CARTRIDGE - 5/32" PLASTIC - MAKE 2
(COUNTERSINK CORNER HOLES, TOP AND BOTTOM)

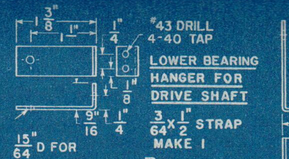


A

LOWER HANGER STRAP FOR SUPPLY AND TAKEUP SHAFTS

2 REQ'D 3/64 X 1/2 STRAP

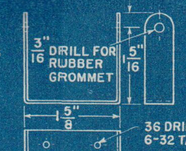
15/64 DRILL FOR 3LI-FF NYLINERS



B

LOWER BEARING HANGER FOR DRIVE SHAFT

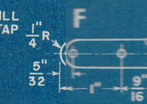
3/64 X 1/2 STRAP MAKE 1



C

MOTOR HANGER

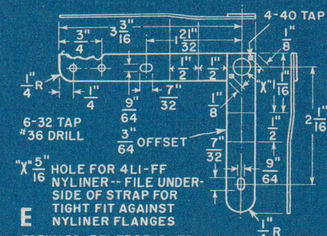
3/64 X 1/2 STRAP - MAKE 1



D

SELECTOR ARM RETAINER - BRASS
MAKE 1

UPPER SELECTOR ARM

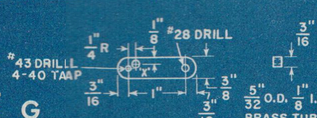


6 STRIP METAL PARTS

E

FORWARD-REVERSE IDLER LEVER

3/64 X 1/2 STRAP - MAKE 1

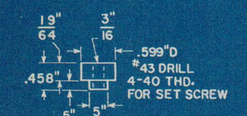


G

LOWER I FUNCTION SELECTOR

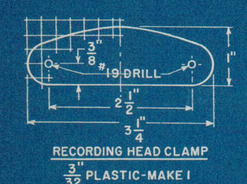
3/64 X 3/8" STRAP - MAKE 1

BRASS TUBING MOUNT AT "X" WITH 4-40 X 3/8" RHS



RECORDING HEAD CLAMP

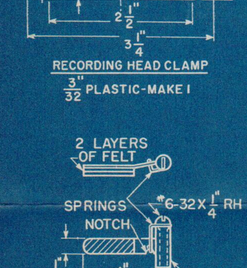
3/32" PLASTIC - MAKE 1



BRASS TUBE

PRESSURE PAD BRACKET

(SPRING BRASS)



SUPPLY AND TAKEUP HUBS

BRASS-MAKE 2

SUPPLY AND TAKEUP SHAFTS

3/16" DRILL ROD - MAKE 2

REWIND IDLER SHAFT MAKE 1

3/16" DRILL ROD

TAKEUP IDLER SHAFT MAKE 1

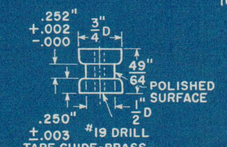
3/16" DRILL ROD

PRESSURE WHEEL SHAFT - MAKE 1

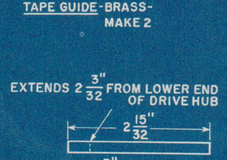
PRESSURE WHEEL SHAFT - MAKE 1

TAPE DRIVE WHEELS

BRASS - MAKE 2



TAPE GUIDE - BRASS - MAKE 2



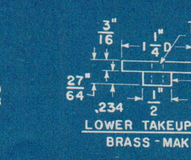
DRIVE SHAFT - 3/16" DRILL ROD - MAKE 1

(SHORTEN HUB THIS END)

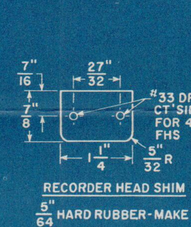
REWIND IDLER (WALSCO 1450)

LOWER TAKEUP WHEEL

BRASS - MAKE 1

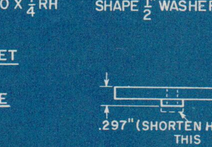


TAKEUP IDLER (WALSCO 1433)

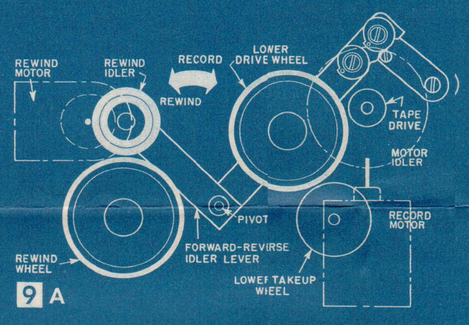


RECORDER HEAD SHIM

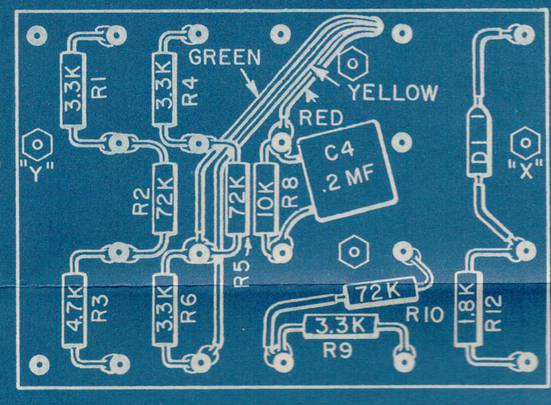
5/64 HARD RUBBER - MAKE 1

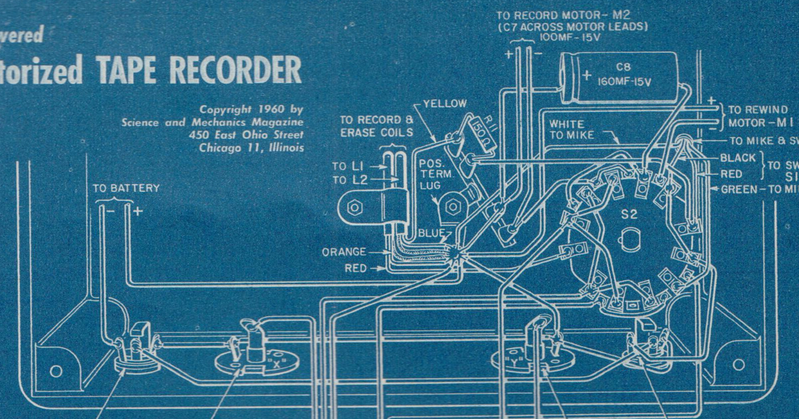


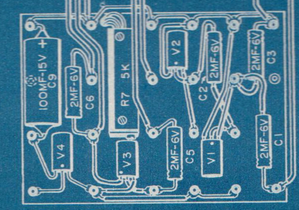
LOWER BEARING HANGER FOR FUNCTION SELECTOR



9 A

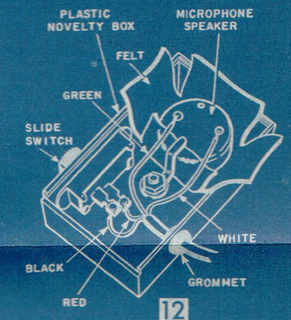






TOP VIEW OF TERMINAL BOARD

11 PICTORIAL



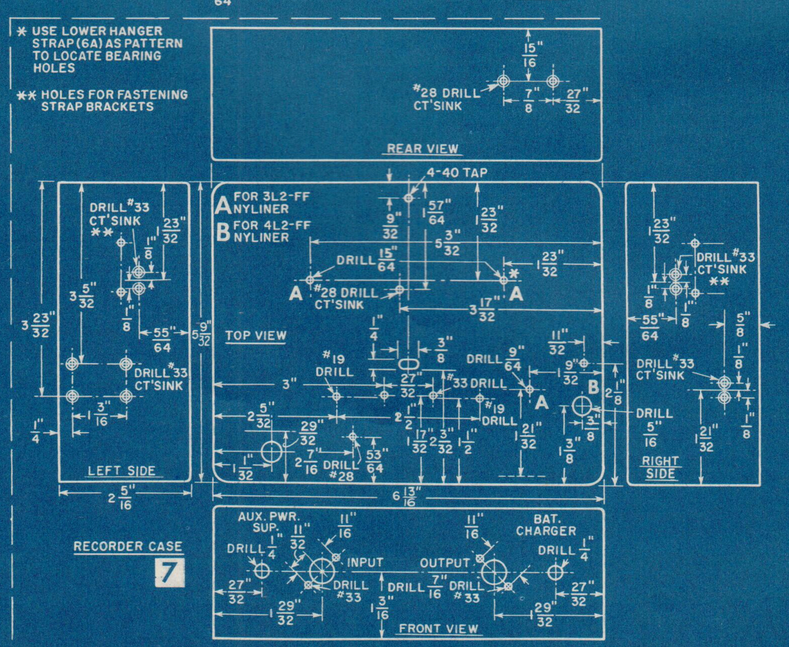
12

BOTTOM VIEW OF TERMINAL BOARD

USE ACTUAL SIZE DRAWING (LEFT) AS DRILLING TEMPLATE

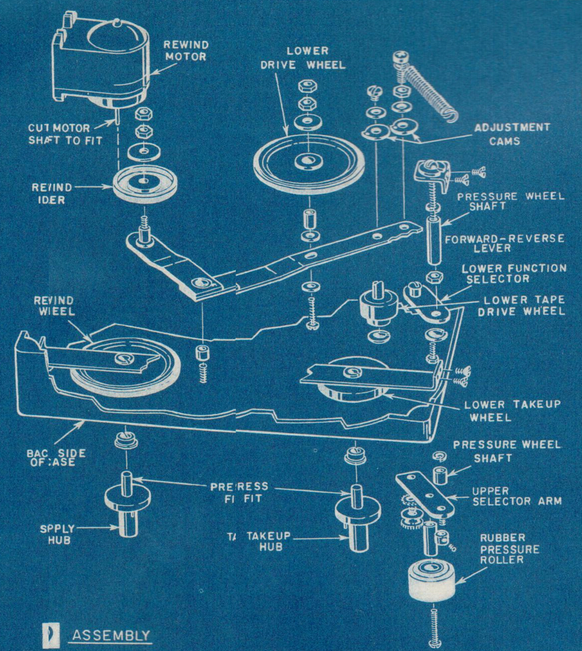
* USE LOWER HANGER STRAP (6A) AS PATTERN TO LOCATE BEARING HOLES

** HOLES FOR FASTENING STRAP BRACKETS

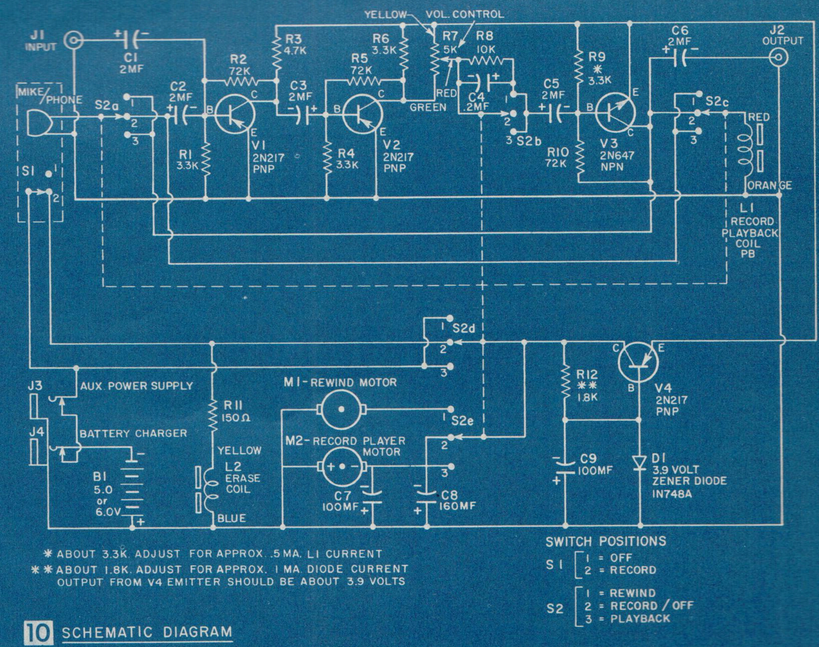


RECORDER CASE

7



ASSEMBLY



* ABOUT 3.3K. ADJUST FOR APPROX. .5 MA. L1 CURRENT

** ABOUT 1.8K. ADJUST FOR APPROX. 1 MA. DIODE CURRENT OUTPUT FROM V4 EMITTER SHOULD BE ABOUT 3.9 VOLTS

SWITCH POSITIONS

S1 [1 = OFF, 2 = RECORD]

S2 [1 = REWIND, 2 = RECORD / OFF, 3 = PLAYBACK]

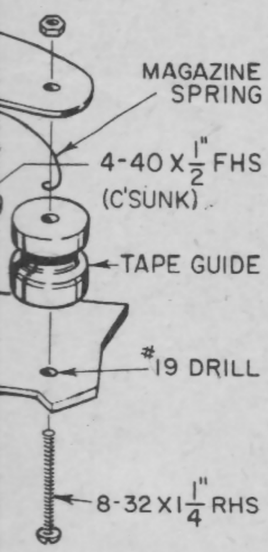
10 SCHEMATIC DIAGRAM

WER BEARING
HANGER

RIVE

FT 2

LAMP FOR HEAD



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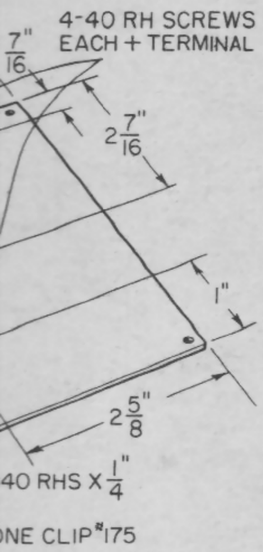

NE CLIP #175

BATTERY PACK 4

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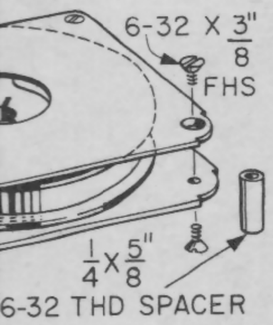

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CIENCE AND MECHANICS

One-Tube Tin Can Receiver

Here is an inexpensive one-tube broadcast band receiver that will give four-tube performance. Stations nearly 70 miles away come in with good loudspeaker volume

By JOE A. ROLF, K5JOK

A one-lb. tobacco can contains the receiver and its 4" PM speaker. Tuning and volume controls are on top of the lid, speaker is mounted in the bottom of the can. Power cord and antenna lead also enter the cabinet from the bottom.

1

IF you're a pipe smoker, you no doubt already have a cabinet for this receiver. If not, you probably have a friend who buys his tobacco in a one-lb. can. An empty cigar tin or a two-lb. coffee tin can also be used or, if desired, the unit can be easily built on a small standard chassis.

A Prince Albert tobacco can, 5 in. high and 5 in. dia., was used as cabinet by the author. Some tobaccos are packaged in slightly smaller containers and using one of these may make it necessary to alter the parts layout slightly from that shown in Figs. 3 and 4. However, with care there will be no difficulty in getting the components to fit easily in any one-lb. tin you use.

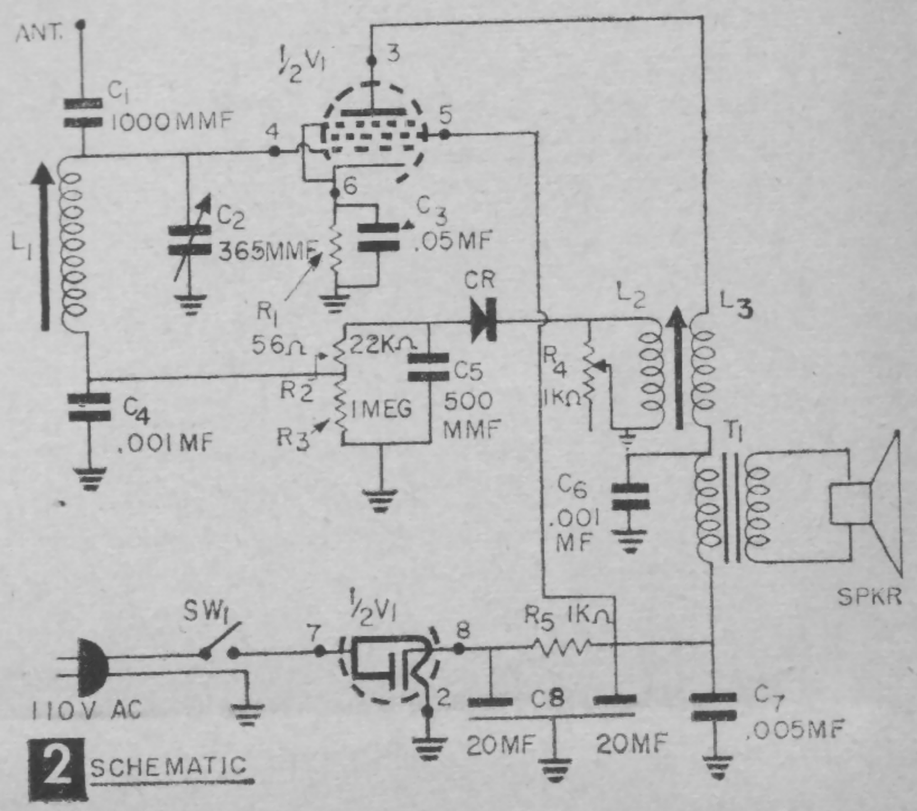
If you're an old-timer in radio, you'll probably recognize the circuit shown in Fig. 2. Similar to those popular in the days when multi-tubers were large and cumbersome and vacuum tubes expensive, it's a reflex circuit designed for economy and compactness and making a single tube do the work of two—both RF and AF amplifier. Here's how the reflex circuit shown in Fig. 2 works:

The 117N7/GT contains a rectifier and power pentode section in the same envelope. The rectifier is employed as a half-wave power supply, the pentode works as a combination RF-AF amplifier. A crystal diode (CR) is used for an RF detector.

Radio signals enter the receiver from the antenna through C1 and the desired station is selected by the tuned circuit formed by C2 and L1. The selected signal is then amplified by the tube which is biased for RF amplification by the cathode resistor R1. The amplified signal appears across L3 in the plate lead of the tube and, since L3 and L2 form an RF transformer, RF is transferred to L2; RF does not flow through the primary of the output transformer T1, but is passed to ground by C6 which offers very little impedance to RF.

The amplitude of the signal appearing across L2 is controlled by R4 (the volume control). This voltage is rectified by diode CR, and an AF voltage appears across the detector load, R2 and R3. Any RF still present at this point is passed to ground by C4 and C5 which have low impedance to radio frequencies, but high to audio frequencies.

The grid of the tube is connected between



2 SCHEMATIC

R2 and R3 where the AF voltage is negative with respect to ground. This negative audio voltage, acting through L1 (low AF impedance) biases the tube automatically and causes it to act as an AF amplifier. The AF signal in the tube's plate lead is not affected by L3, nor is it transferred to L2. Nor is it grounded by C6. Instead, it appears across the primary of the audio transformer T1 to operate the speaker connected to the secondary winding.

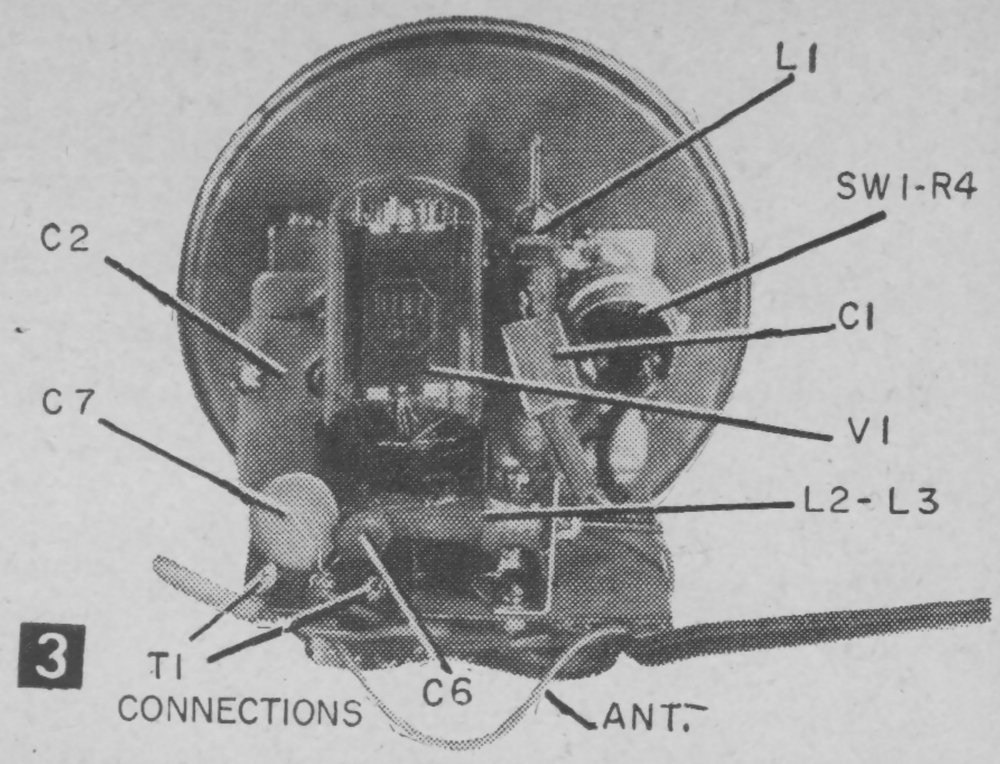
Construction. The receiver is built with the speaker and output transformer mounted in the bottom of the can and other components mounted on an L-shaped chassis which is fastened to the lid of the can by the volume control shaft and two machine screws. The chassis may either be of aluminum or sheet metal. Sheet metal will be somewhat harder to work, but will allow the builder to solder ground connections directly to the chassis without using solder lugs.

Form the chassis from a piece of material 3¼ x 5 in. bent to a right angle with sides measuring 2 x 3¼ in. and 3 x 3¼ in. The 2-in. side fastens to the lid with the other leg of the angle centered about ¾ in. from one edge of the lid. The 2 x 3¼-in. covers most of the lid to reinforce the thin material to which it is attached. The 3-in. leg is used for mounting the components.

Tuning capacitor, C2 and volume control R4 are placed so that their shafts are centered in the lid. The tube socket is placed behind C2 as close as possible. Transformer L2-L3 is mounted horizontally next to the tube as shown in Fig. 3, while L1 is mounted in a vertical position between the tuning capacitor and volume control. A two-lug terminal strip on the top of the chassis, at the right rear edge, is used to connect the output transformer leads to the chassis. Capacitors C6 and C7 are also mounted on this strip.

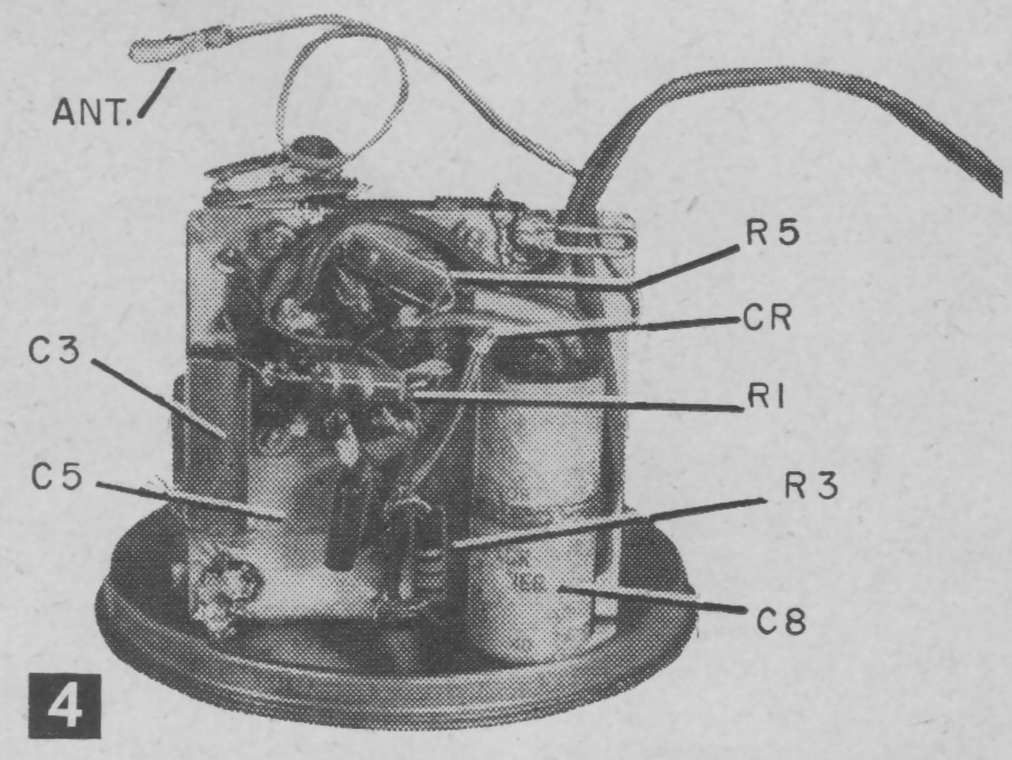
Filter capacitor C8 is placed on the right underside of the chassis and next to it, toward the front, is a two-lug terminal strip for mounting R2, R3, and C5. The layout of the remaining components is not critical, but care should be taken that the lid will fit properly with everything mounted and that the grid and plate leads are separated as much as possible to avoid the possibility of feedback. It is particularly important that L1 and L2 be mounted at right angles to one another and separated as much as possible in order to minimize coupling.

The RF transformer L2-L3 is made by winding 75 turns of litz wire (obtainable from a discarded RF or IF coil) over the windings of a ferrite antenna coil. The added



3

Chassis for the receiver is an L-shaped bracket which fastens to the tobacco can lid. This photo shows the layout of parts on the topside of the chassis. Leads from the output transformer are soldered to the terminal strip at the rear edge.



4

Underside of chassis. Holes for bringing leads from the top of the chassis should be placed so that plate and grid leads are short and separated from one another.

winding should be secured with several coats of coil dope or finger-nail polish. The original winding is L2; the added winding, L3.

A 12-in. piece of hookup wire brought out of the cabinet with the power cord serves as an antenna lead-in to the chassis. A pin-jack from a discarded tube socket can be soldered to this wire and shielded with tape or plastic tubing to make a handy antenna jack.

Mount the speaker in the bottom of the can with four machine screws. Output transformer T1 can be mounted with screws or soldered in place. If the recommended speaker is not used, its replacement should not extend above the bottom of the can more than 1¾ in., otherwise the chassis may have to be made smaller.

Small holes in the bottom of the can serve as a speaker grille. Or, for better tone, cut a 4-in. dia. hole in the bottom with a sharp

MATERIALS LIST—T

Desig.	Description
C1	100 mmf. mica capacitor
C2	365 mmf. variable (double pacitor
C3	.05 mf. 200 WV midget tu
C4	.001 mf. disc ceramic capac
C5	500 mmf. mica capacitor
C6	.001 mf. disc ceramic capa
C7	.005 mf. disc ceramic capa
C8	20-20 mf. 150 WV dual BBRD 2215) capacitor
Cr	1N34 or CK-705 diode
L1	hi-Q ferrite antenna coil
L2	hi-Q ferrite antenna coil
L3	75 turns of litz wire woun
R1	56 ohm, ½ watt resistor
R2	22,000 ohm, ¼ watt resis
R3	1 megohm, ¼ watt resisto
R4	1,000 ohm, ¼ watt volum
R5	1,000 ohm, 1 watt resistor
Spk	4" PM replacement type sp or Cletron PM-4P2)
Swl	SPST switch (on volume co
T1	3,000/3.2 ohm, 3-watt out
V1	117N7/GT tube
	1 wafer or saddle-mount (2-lug type), twenty ⅛ cord with plug, 3¼ x 5 minum or sheet metal, tinned, solder & hook-up

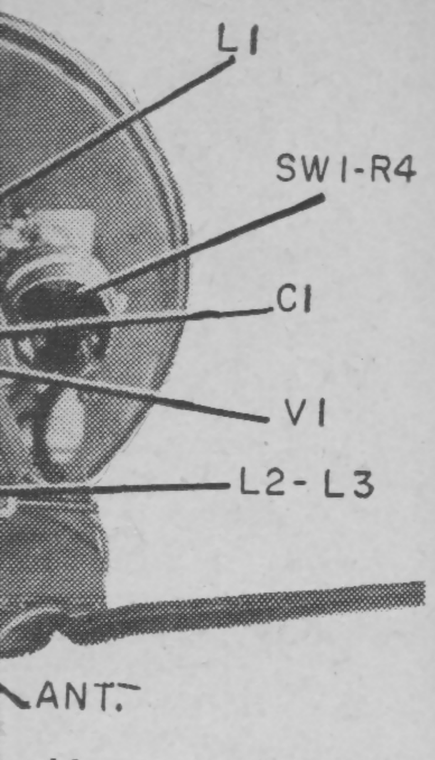
knife. But watch the sh mounting holes for spea former have been drill edge for the power cor forated cardboard over to protect the speaker c

Then make three ha vered copper wire form in. high and soldered i use untinned copper w ished and given a coa polish to retard tarnish

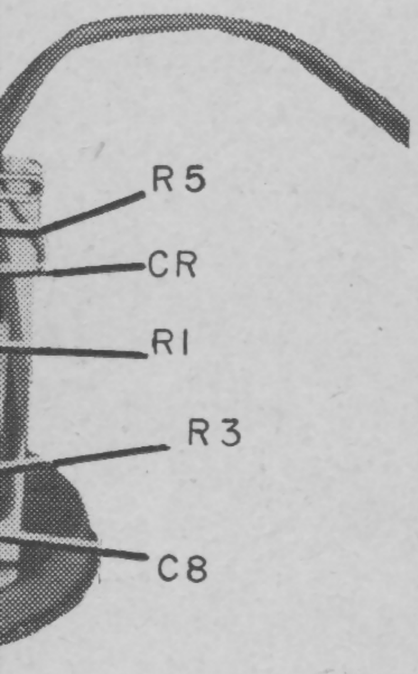
With completion of speaker mounting, brin antenna lead through t of the can and attach solder the output trans to the lugs of the termi the chassis. These le enough to permit the from the cabinet with t

To test the unit, use set should never be gr a metal surface.) With turn the set on and adv trol to maximum. Che ments are lit before tu If working properly, th stations clearly—or wi case, find a strong stat the band and adjust L tion. At some point of will become distorted. this point.

Because of the meta sence of a loop antenn tenna is necessary. For hook-up wire is suffic tions, a longer length s will do. When the set



ped bracket which fastens
shows the layout of parts
ds from the output trans-
al strip at the rear edge.



ringing leads from the
so that plate and grid
from one another.

d with several coats
polish. The original
winding, L3.
p wire brought out
ower cord serves as
chassis. A pin-jack
ket can be soldered
with tape or plastic
ntenna jack.
e bottom of the can
ws. Output trans-
ed with screws or
commended speak-
ent should not ex-
the can more than
sis may have to be

m of the can serve
better tone, cut a
tom with a sharp

MATERIALS LIST—TIN CAN RECEIVER

Desig.	Description
C1	100 mmf. mica capacitor
C2	365 mmf. variable (double-bearing replacement type) capacitor
C3	.05 mf. 200 WV midget tubular capacitor
C4	.001 mf. disc ceramic capacitor
C5	500 mmf. mica capacitor
C6	.001 mf. disc ceramic capacitor
C7	.005 mf. disc ceramic capacitor
C8	20-20 mf. 150 WV dual electrolytic (Cornell Dubilier BBRD 2215) capacitor
Cr	1N34 or CK-705 diode
L1	hi-Q ferrite antenna coil
L2	hi-Q ferrite antenna coil
L3	75 turns of litz wire wound over L2 (see text)
R1	56 ohm, ½ watt resistor
R2	22,000 ohm, ¼ watt resistor
R3	1 megohm, ¼ watt resistor
R4	1,000 ohm, ¼ watt volume control (with SPST switch)
R5	1,000 ohm, 1 watt resistor
Spk	4" PM replacement type speaker, 3.2-ohm coil (Jensen 4J6 or Cletron PM-4P2)
Swl	SPST switch (on volume control R4)
T1	3,000/3.2 ohm, 3-watt output transformer
V1	117N7/GT tube
	1 wafer or saddle-mount octal socket, 2 terminal strips (2-lug type), twenty ⅛ x ¼" machine screws, 5' power cord with plug, 3¼ x 5" pc. of #16 or #18 ga. aluminum or sheet metal, 12" #8 copper wire, plain or tinned, solder & hook-up wire.

knife. But watch the sharp edges! When the mounting holes for speaker and output transformer have been drilled plus a hole at one edge for the power cord, glue a piece of perforated cardboard over the bottom of the can to protect the speaker cone.

Then make three hairpin legs of #8 silvered copper wire formed into V shapes 1¼ in. high and soldered in place. For gold legs, use untinned copper wire that has been polished and given a coat of clear finger-nail polish to retard tarnishing.

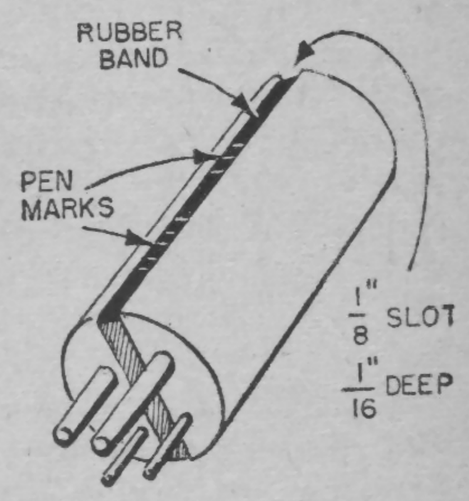
With completion of chassis wiring and speaker mounting, bring the power cord and antenna lead through the hole in the bottom of the can and attach a power plug. Next, solder the output transformer primary leads to the lugs of the terminal strip at the rear of the chassis. These leads should be long enough to permit the chassis to be removed from the cabinet with the speaker in place.

To test the unit, use a long antenna. (The set should never be grounded or operated on a metal surface.) With an antenna connected, turn the set on and advance the volume control to maximum. Check and see if the filaments are lit before tuning across the band. If working properly, the receiver will receive stations clearly—or with a whistle. In either case, find a strong station at the high end of the band and adjust L2's slug for best reception. At some point of adjustment the audio will become distorted. Set the slug just below this point.

Because of the metal cabinet and the absence of a loop antenna, a short external antenna is necessary. For local stations, 4 ft. of hook-up wire is sufficient. For distant stations, a longer length strung around the room will do. When the set is working properly, connect a short antenna and adjust L1 so that C2 tunes the entire broadcast band and then adjust the slug on L2 again for best reception. The receiver is now ready to be placed in its cabinet.

A small amount of regeneration requires the initial adjustment of L2 to avoid distortion or oscillation at the upper edge of the band. This also tends to make the receiver more sensitive on the high end of the band, but volume for all stations is nearly the same due to the AVC action of the audio bias. While not as selective, the receiver has better tone than most small table-models, despite the small speaker and tin cabinet. If poor selectivity is noticed when the set is operated near local, high-power stations, reduce the value of C1 by about half.

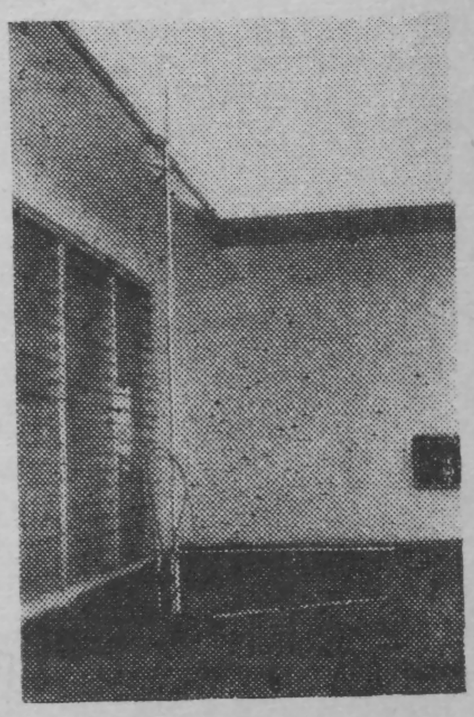
Coil-Winding Tip



• Amateur radio operators who wind their own short wave coils know how difficult it sometimes is to properly space and anchor just a few turns of wire. The solution is to saw or file two opposite slots ⅛ in. wide and about 1/16 in. deep on the top edge of the coil form. Place a wide, flat No. 32 rubber band in these slots and stretch it over the form and between two pairs of prongs. Fountain pen or ball pen marks are easily made on the rubber band, exactly where each turn of wire should pass. Draw the wire tightly to embed it in the insulating rubber and hold it neatly in place without the use of cement.

—Karl L. Martin.

Invert Aerial to Speed Installation



• The neighbors may think you're crazy if you start the installation of a TV or radio aerial upside down, but doing this will help you to quickly and easily align a bracket on the edge of your house. By having the mast parallel a corner of the building, one of the windows, or some other vertical part, it is easy to sight the alignment while adjusting the mounting bracket. Then you need only reverse the mast to finish the job.

Transmitter for the Novice

Novice transmitter shown here atop a Knight-Kit receiver, is powered by an external power supply, permitting fixed or mobile use. Inset shows closeup of transmitter face.

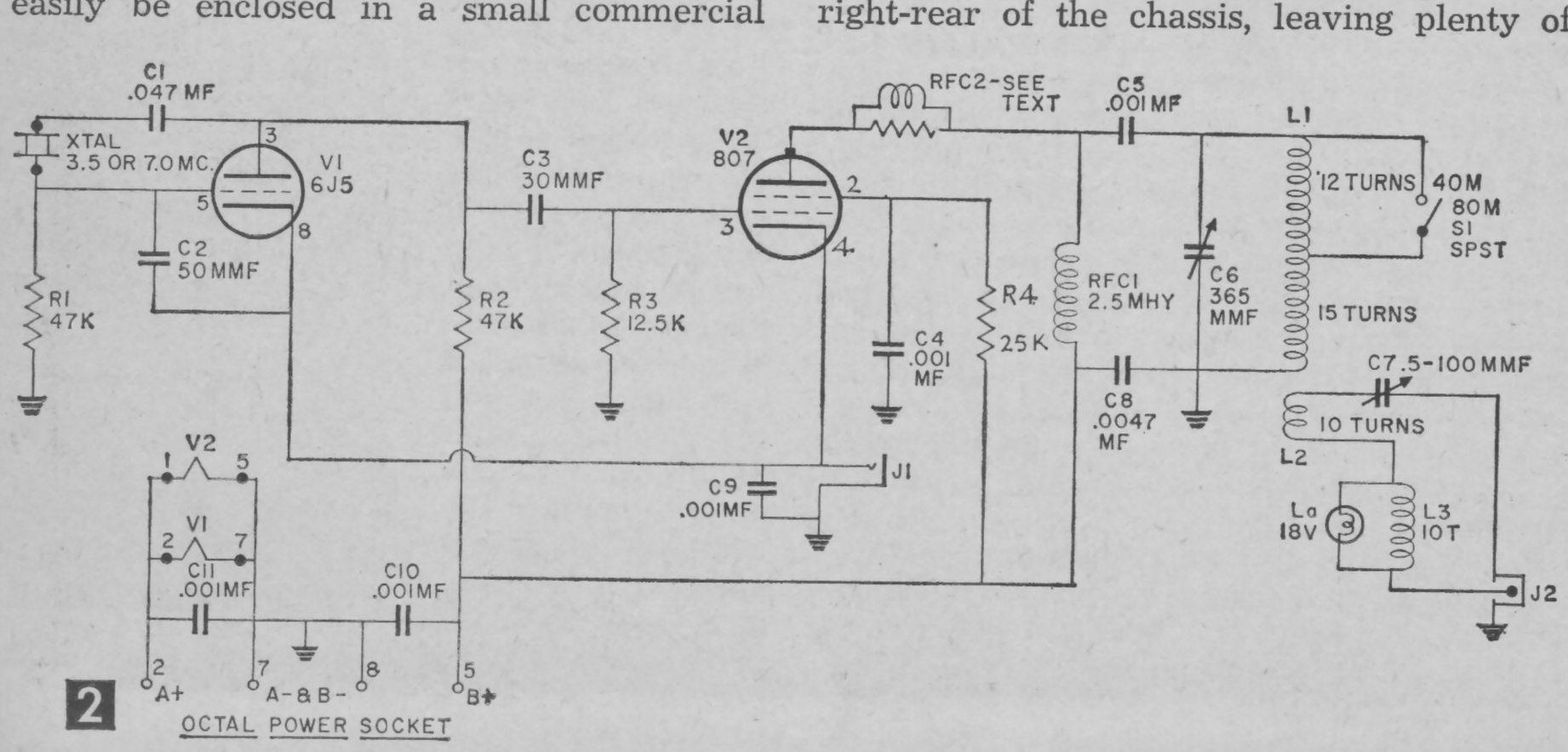
By ALICE ROLF, KN5SEL

HERE'S a compact 75-watt transmitter that even a Novice YL can build. In fact, a Novice XYL did build it after her husband drilled the panel and took over as babysitter. The rig puts out a good signal on 40 and 80 meters, featuring bandswitching, and can be used either at home or in the car with a suitable power supply.

The two-tube circuit shown in Fig. 2 fits into a U.S. Army 30 cal. ammunition tin, available at surplus stores. The 3¼ x 6¾ x 10¼-in. cabinet is modern enough to enhance any shack, and small enough to fit comfortably under the dash of even a foreign car. If an ammo tin is not available, the circuit can easily be enclosed in a small commercial metal cabinet available from radio supply houses.

The transmitter is built in a 5¾ x 9¾-in. hardboard chassis, with a 3¼ x 10⅛-in. metal panel bracket-attached. Use two brackets of any convenient size and sturdy enough to support the panel, which extends about ¼-in. below the Masonite.

Drill all the panel holes before fastening the panel to the chassis. The power socket, key jack, band switch, tuning capacitors, dial light jewel, and antenna jack mount on this panel, the remainder of the components mount on the chassis. The 807 socket mounts on an aluminum bracket 1¾-in. high at the right-rear of the chassis, leaving plenty of



2

Design/No. Req'd.	Description
C1	.047 mfd 200 wv tubular
C2	50 mmfd mica
C3	30 mmfd mica
C4	.001 mfd 1 kv, disc
C5	.001 mfd 1.5 kv tubular
C6	365 mmfd single gang broa
C7	5-100 mmfd variable (Bud
C8	.0047 mfd 1 kv, disc
C9	.001 mfd, 1 kv, disc
C10	.001 mfd, 1 kv disc
C11	.001 mfd, 1 kv, disc
J1	phono jack, single circuit (
J2	miniature coax jack
L1	27 turns #22 enameled cl 15 turns from bottom
L2	10 turns #22 enameled cl
L3	10 turns #22 or #18 ena
La	#1455 18-V pilot lamp
RFC 1	2.5 mhy, 100 ma RF choke
RFC 2	parasitic choke or 5 turns on 50-ohm, 1-watt resistor

room for the 807. Plac
tween the panel and th

Mount the socket for
side of the chassis. Clip
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drill holes in the hardboa
solder lugs extend throug
holes are aligned by fi
hole for the key pin of
of finger-nail polish on
and press it against the
in the drilled hole. Th
hole locations. After dr
into the holes until th
flush with the chassis. B
back so that they lock t
place.

Mount the remainder
ponents on #8 terminal
are fastened to the ha
6-32 x ¼-in. machine scr
for the two connection
This choke is mounted o
lug terminal strips in orc
the high RF potential
metal cabinet. Parts la
critical, but should be si
shown in Fig. 3.

Extend a length of #1
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it to the panel for a gro
Connect the 807 moun
to this bar. All ground
be connected to this bu
or the 807 mounting br

Connect the leads to th
and bring them to the
chassis through holes dr
the tube socket. Indicat
minals must not be gro
ported by two pieces of

Coils L1 and L2 are
wire wound in a 1-in.
can be a commercial
brackets, or a cardboar

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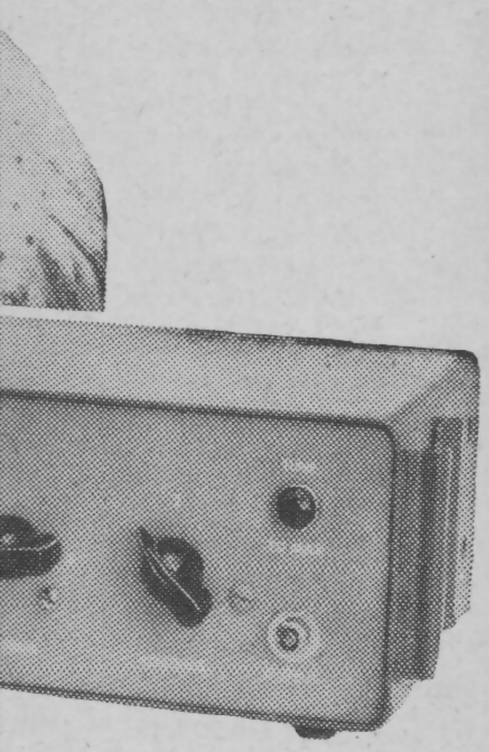

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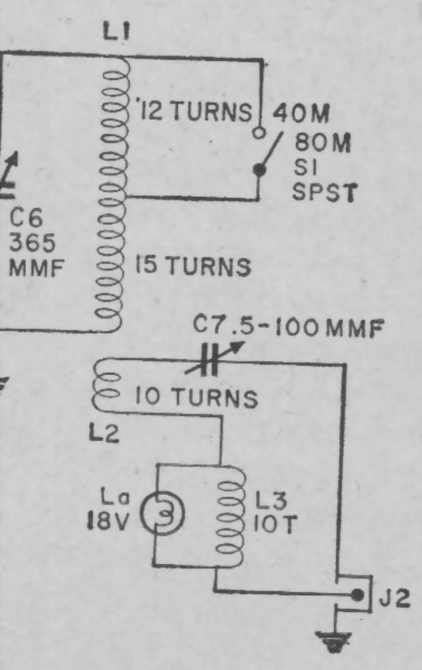


MATERIALS LIST—NOVICE TRANSMITTER

Design/No. Req'd.	Description
C1	.047 mfd 200 wv tubular
C2	50 mmfd mica
C3	30 mmfd mica
C4	.001 mfd 1 kv, disc
C5	.001 mfd 1.5 kv tubular
C6	365 mmfd single gang broadcast type variable (Philmore)
C7	5-100 mmfd variable (Bud MC 1873)
C8	.0047 mfd 1 kv, disc
C9	.001 mfd, 1 kv, disc
C10	.001 mfd, 1 kv disc
C11	.001 mfd, 1 kv, disc
J1	phono jack, single circuit (Mallory)
J2	miniature coax jack
L1	27 turns #22 enameled close wound on 1" form, tapped 15 turns from bottom
L2	10 turns #22 enameled close wound over top half of L1
L3	10 turns #22 or #18 enameled close wound ½" form
La	#1455 18-V pilot lamp
RFC 1	2.5 mhy, 100 ma RF choke (National)
RFC 2	parasitic choke or 5 turns #22 or #18 enameled wound on 50-ohm, 1-watt resistor
R1	47,000 ohm, ½ watt
R2	47,000 ohm, 1 watt
R3	12,500 ohm, 10 watt
R4	25,000 ohm, 10 watt
S1	SPST toggle switch (Arrow-Hart & Hegmen #20994NV)
V1	6J5 vacuum tube
V2	807 vacuum tube
Xtal	80- or 40-meter crystal—for Novice band 3750 KC to 3800 KC (80 M) or 7150 to 7200 KC (40 M)
20	6-32 x ¼" machine screws and nuts
10	#8 terminal lugs
2	single lug terminal strips
1	dial lamp jewel
1	ceramic octal socket (6J5)
1	5-prong socket (807)
2	octal wafer sockets (xtal and power sockets)
1	octal plug (for power cable)
1 pc	hardboard ¾ x 5 x 10" (chassis)
1 pc	1/16" steel or aluminum 3¼ x 10" (panel)
6 ft	4-wire rubber insulated cable (insulated for 1000 volts)

room for the 807. Place the tank coil between the panel and the 807 (Fig. 3).

Mount the socket for the 6J5 on the left side of the chassis. Clip the mounting saddle of the socket away with a pair of snips and drill holes in the hardboard so that the socket solder lugs extend through the chassis. These holes are aligned by first drilling the key hole for the key pin of the 6J5. Put a drop of finger-nail polish on the pins of the 6J5 and press it against the chassis with the key in the drilled hole. The polish will mark hole locations. After drilling, press the lugs into the holes until the socket is flush with the chassis. Bend the lugs back so that they lock the socket in place.

Mount the remainder of the components on #8 terminal lugs which are fastened to the hardboard by 6-32 x ¼-in. machine screws—except for the two connections of RFC1. This choke is mounted on two single lug terminal strips in order to isolate the high RF potentials from the metal cabinet. Parts layout is not critical, but should be similar to that shown in Fig. 3.

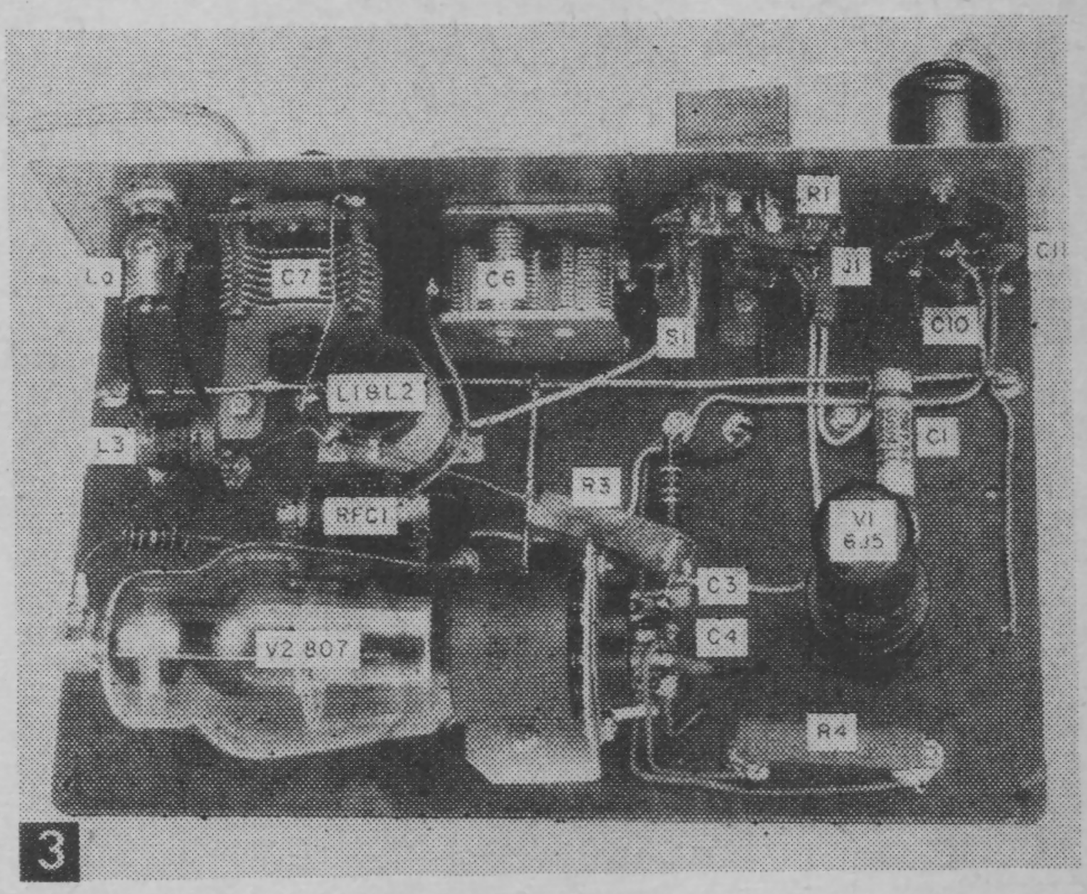
Extend a length of #12 wire across the front of the chassis and ground it to the panel for a ground bus bar. Connect the 807 mounting bracket to this bar. All ground leads should be connected to this bus, the panel, or the 807 mounting bracket.

Connect the leads to the 6J5 socket and bring them to the top of the chassis through holes drilled around the tube socket. Indicator lamp terminals must not be grounded; they are supported by two pieces of solid wire.

Coils L1 and L2 are #22 enameled copper wire wound in a 1-in. dia. form. This form can be a commercial unit with mounting brackets, or a cardboard or plastic tube 1½-in. long. L1 is wound with the connection for C5 at the bottom of the form, nearest the chassis, and the ground connection at the top.

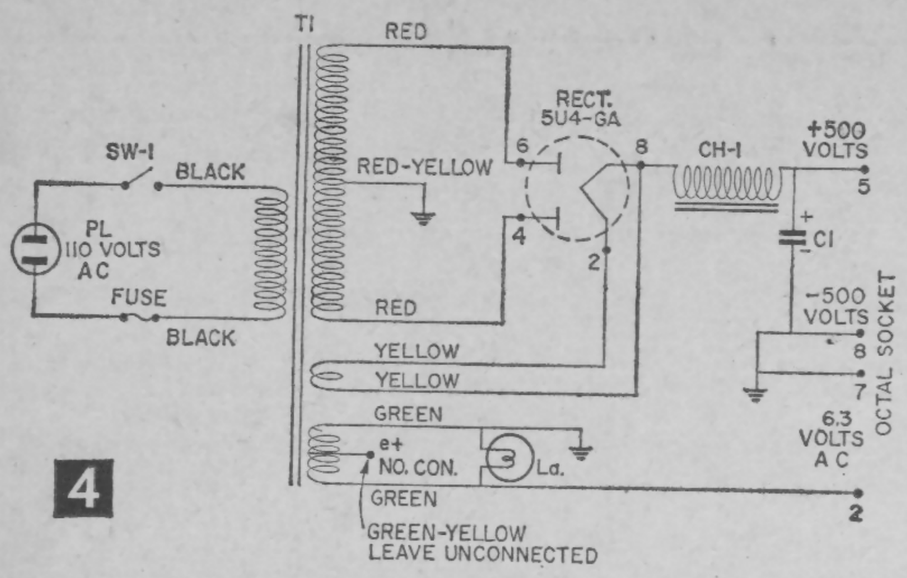
The tap for the bandswitch is placed 12 turns from the bottom of the coil. Twist the wire into a loop for the bandswitch connection and wind the other 15 turns. Coil L2 is wound over the top of L1 between the bandswitch tap connection and the top of the form. Wind it over a layer of Scotch tape with the connection to C7 at the top of the form.

Coil L3 consists of 10 turns of #22 or #18 enameled wire close-wound on a ½-in. form; RFC 2 can either be a commercial parasitic choke of five turns of #22 or #18 enameled wire wound on a 47 ohm, 1-watt resistor. For the antenna jack (J2 in Fig. 2) use a miniature connector jack of a coax type.



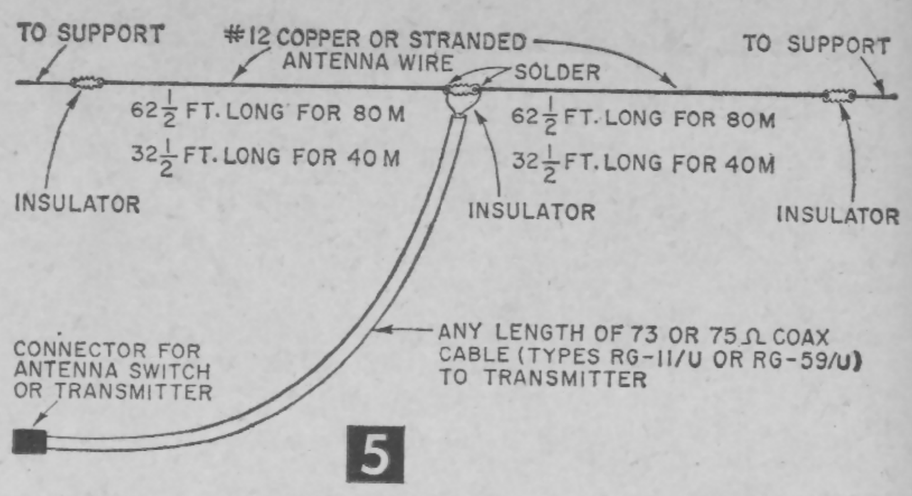
3

Components are mounted on terminal lugs, the 807 socket is mounted on an aluminum bracket and the 6J5 socket mounts similar to sockets in printed circuitry. A wafer-type octal socket is used for the crystal.



4

Power supply for novice transmitter.



5

Antenna recommended for use with novice transmitter. Should be as high and clear of obstacles as possible. Solder inner conductor of coax cable to one side of center insulator, and outer conductor to other side. Tape cable to insulator to relieve strain on soldered joints. Ground outer conductor of cable at the transmitter.

POWER SUPPLY PARTS LIST

Part	Description
C1	12 mfd. 700 W.V.D.C. electrolytic capacitor (Cornell Dubilier BRHV 712, or equiv.)
CH1	7 or 8 hy. 200 to 250 ma. filter choke (Thordarson 20C56, or equiv.)
Fuse	3 amp fuse, with holder
La	#47 pilot lamp, with holder
PL	Line cord, heavy duty
SW1	SPST switch (On-Off switch)
T1	1200 volt c.t. @ 200 to 260 ma. power transformer with 5 volt, 3 amp, winding; 6.4 volt, 3 amp, winding. (Stancor PC-8414, or Burstein-Applebee Co., Kansas City, special #3B164, or equiv.)
Rect	5U4-GA tube
Misc:	2 octal sockets, chassis, mounting screws, etc.
Note:	BA #3B164 transformer has 350 volt tap, at 10 ma, and 5 volt, at 2 amp., windings in secondary. These should be left unconnected if the unit is used.

Use a 3- or 4-wire cable to connect the transmitter to the power supply. The power supply should be capable of delivering from 500 to 750 *v* at 150 *ma* for plate voltage, and 6.3 *v* at 1.2 *amps* filament voltage. For fixed use, an inexpensive full-wave rectifier circuit will work. For mobile work use a dynamotor or heavy duty vibrapack. At 500 *v*, the input will be about 50 watts; with 750 *v*, about 75 watts. A power supply circuit which will serve well is shown in Fig. 4.

Test the Unit on a non-metallic surface before putting it in the cabinet. Plug in the power cable, key, and a 40- or 80-meter crystal. Switch the bandswitch to the band the crystal operates in. Remove the 807 and turn on the power supply. After the tubes have had time to warm up, key the transmitter and listen for the oscillator signal with a shortwave receiver. If nothing is heard, check the oscillator wiring and try a smaller value for C2.

If the oscillator is working, turn off the power supply and insert the 807. If the power supply does not have a bleeder resistor, short the B-plus to ground before replacing the 807 or handling the chassis to avoid shock. Connect a 60-watt light bulb to the antenna terminals and again turn on the power. Place C7 at about half scale and rotate C6 while holding the key down.

With C6 at about half scale, the indicator lamp and the 60-watt lamp will show some sign of output. Adjust C6 and C7 until the indicator lamp (La) glows brightest. Check the plate of the 807; if it is red, replace C3 with a 50 *mmfd* capacitor. This will increase the drive from the 6J5 and allow the final tube to run cool.

If available, a grid-dip meter (or an absorption frequency meter) should be used to check the transmitter's frequency and harmonic output at twice the crystal frequency, and to note the keying characteristics. If carefully constructed, the rig will be clean.

After the transmitter has been tested, place it in the cabinet. Before doing this, however, drill a number of ½-in. holes in the rear of the cabinet and directly above the 807 tube location for ventilation. Then cement a piece of thin Bakelite plastic or three or four layers of "Saran Wrap" to the bottom of the cabinet to insulate the screw heads and 6J5 socket lugs from the cabinet's metal bottom. Secure the unit in the cabinet with two small wood screws on the underside which fasten into the Masonite chassis. Cement rubber feet on the cabinet to avoid scratching surface on which unit stands.

The transmitter will work with most types of popular amateur antennas. We had good results with the antenna rig shown in Fig. 5. The ground lead of the antenna connection should be connected to a good ground. Capacitors C6 and C7 are adjusted until the indicator glows brightest. At this point the transmitter is loaded, and with a good antenna, is capable of working just about any station within range that can be heard on either 80 or 40 meters.

On 80 meters, the daytime range is 50-75 miles and night range is 800-900 miles with 40 to 75 watts input. On 40 meters, with the same input, daytime range is about 200 miles, night range is several thousand miles.

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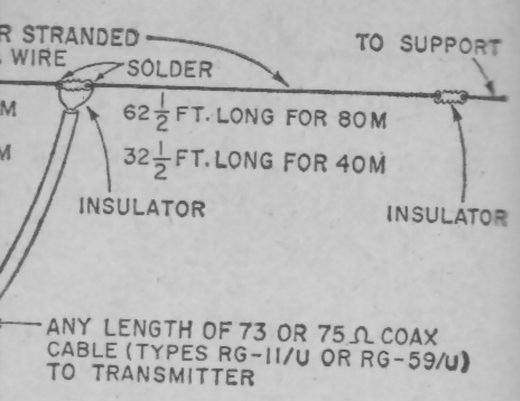

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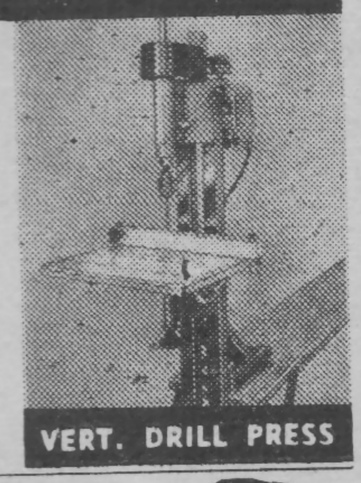

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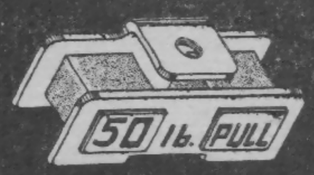

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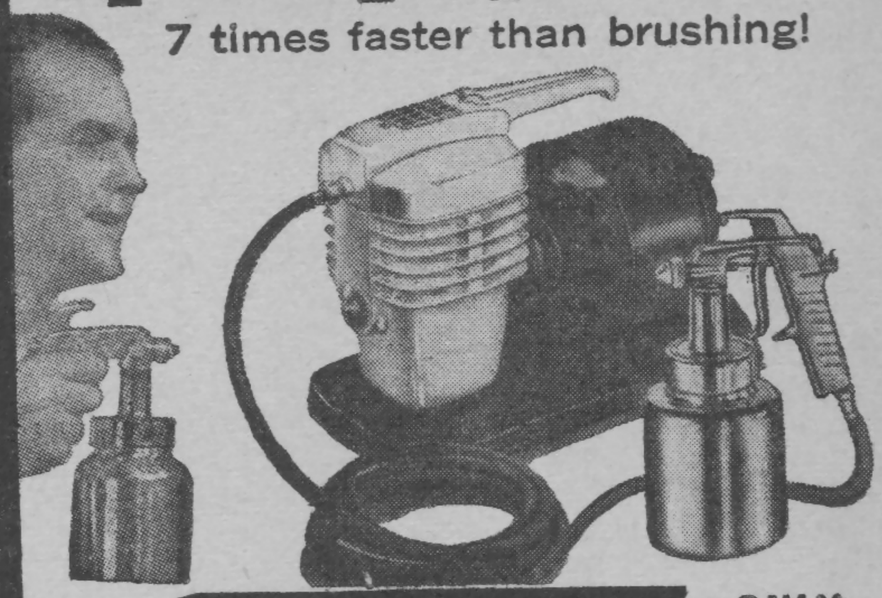

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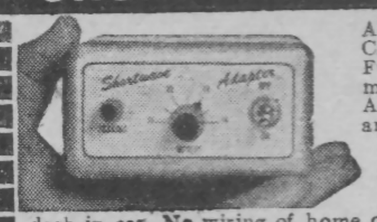

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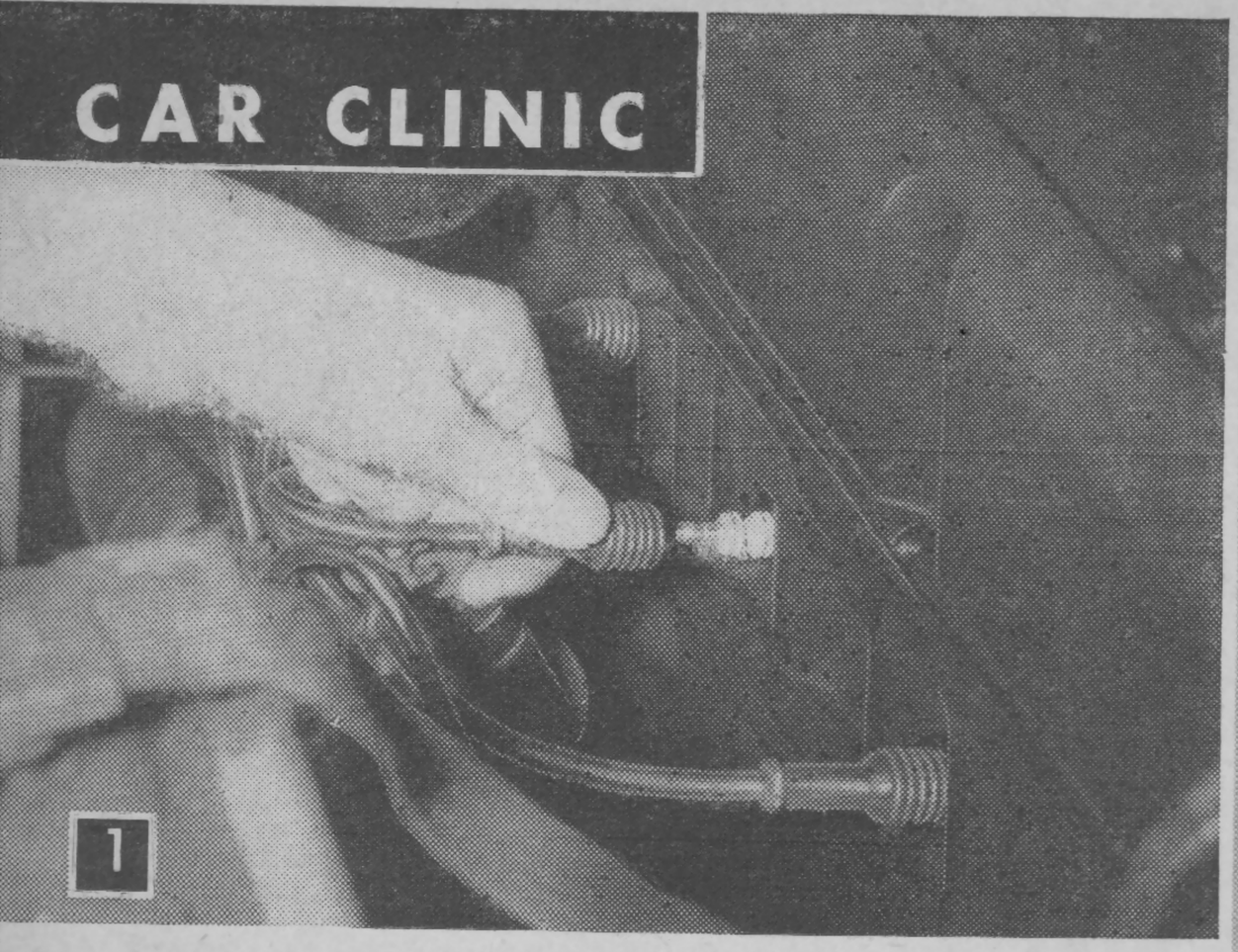


1 To get at your spark plugs, first remove the high tension leads by pulling gently and rotating slightly until the snap terminal releases.

Spark Plug Troubleshooting

Ailing plugs cause engine miss, hard starts and poor fuel mileage. Here's how to both locate and prevent such troubles

By P. K. SNOOK

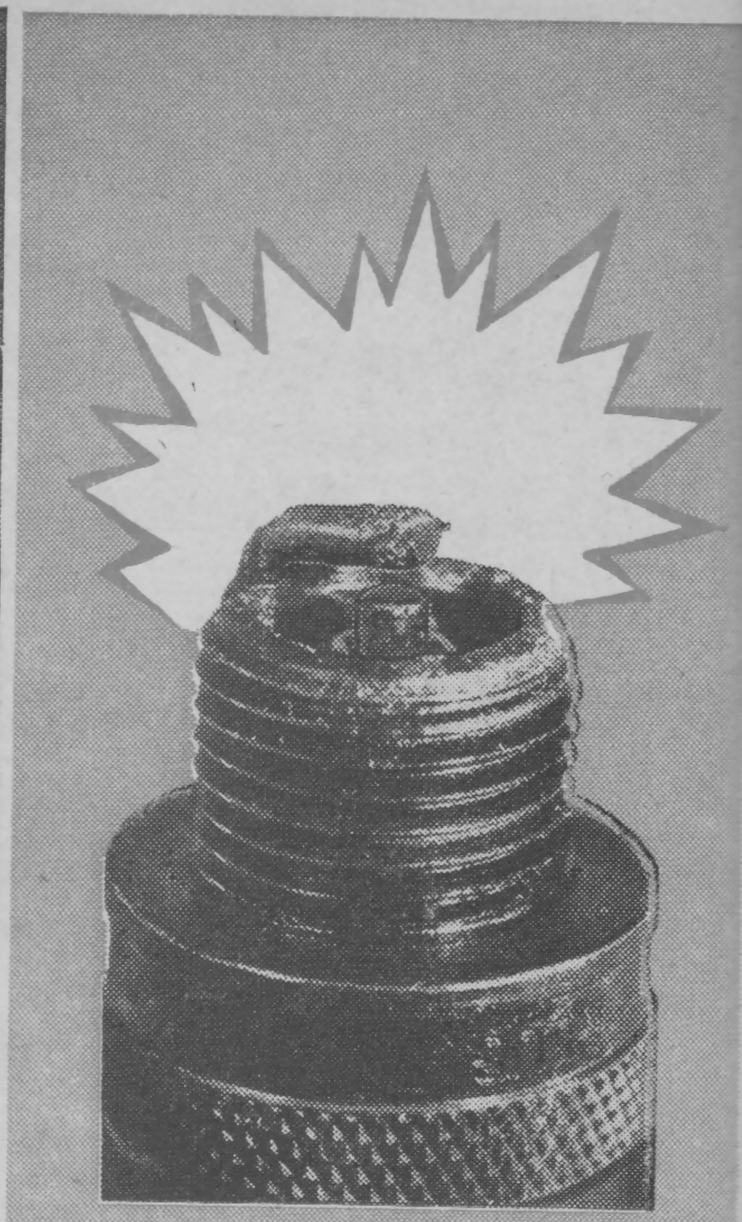
YOU can learn a lot about a car by inspecting its spark plugs.

For example, the type of deposit on the firing end of the plug can reveal how the car has been operating.

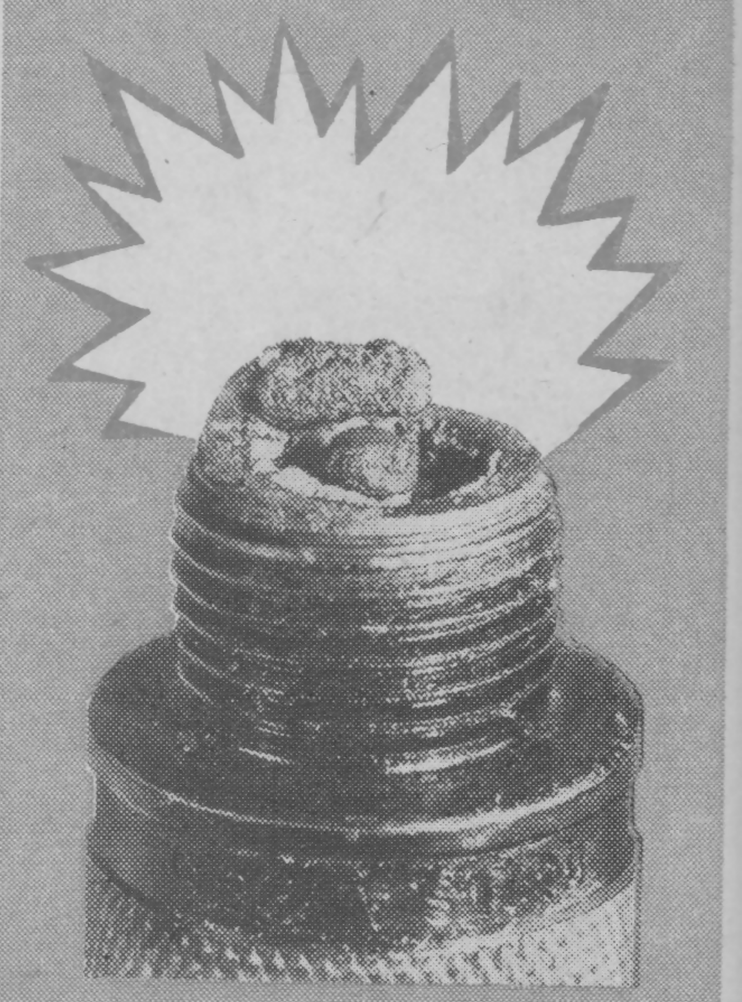
If the deposit is wet, black and oily as in Fig. 2, the car probably pumps oil, due to worn rings, pistons or cylinder walls, or worn or sticky valves. Or the ignition system may not be supplying enough power to the plug.

If, however, the electrodes and inner insulator are covered with black carbon deposits which are hard and baked on, (Fig. 3) you can suspect that too cold a plug is being used in an oil-burning engine, and you need either a hotter plug or, if fouling continues, an engine overhaul.

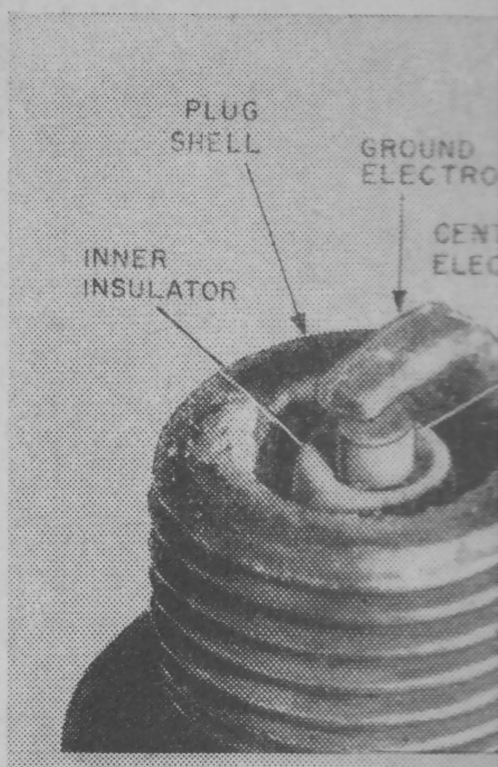
The plug itself may be faulty—with a badly worn electrode or even a cracked insulator. These, too, are clues to the condition of the car, and to the type



2 Wet, oily deposits indicate a severe oil pumping condition in the engine.



3 Hard, black, baked-on deposits are an oil-fouling condition caused by using too cold a plug in an old engine.



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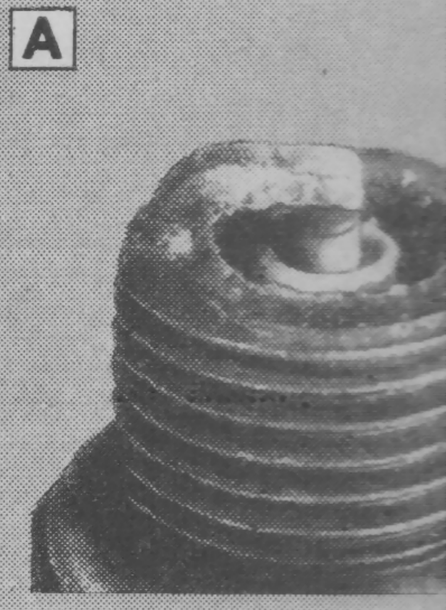

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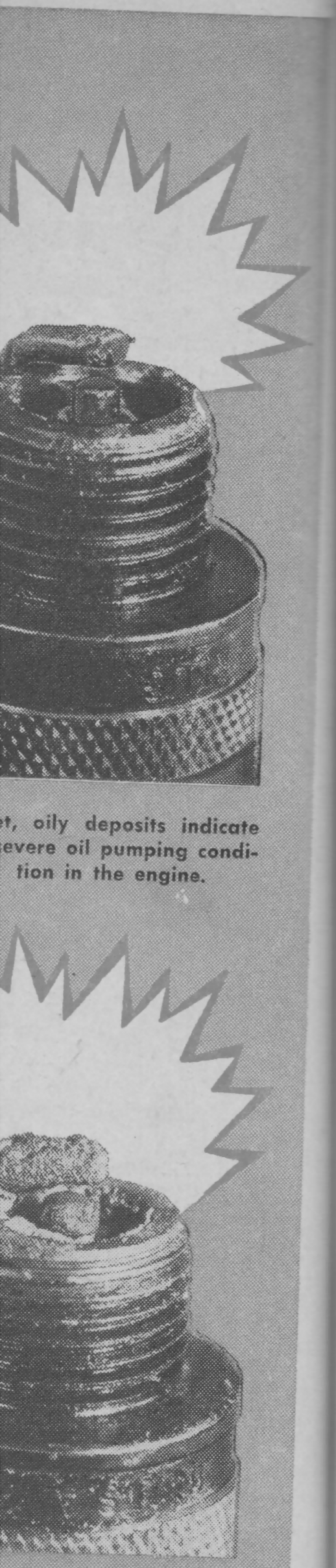
4 Three stages of gas fouling. Top, mild foul sulting from sustained ci fic (slow speed) driving. moderate fouling from miles of operation. Both should be serviceable sandblast cleaning and ping. Below, what h after 8,000 miles without ing. Deposits are so com they would be extremel cult to remove, and plug be replaced.



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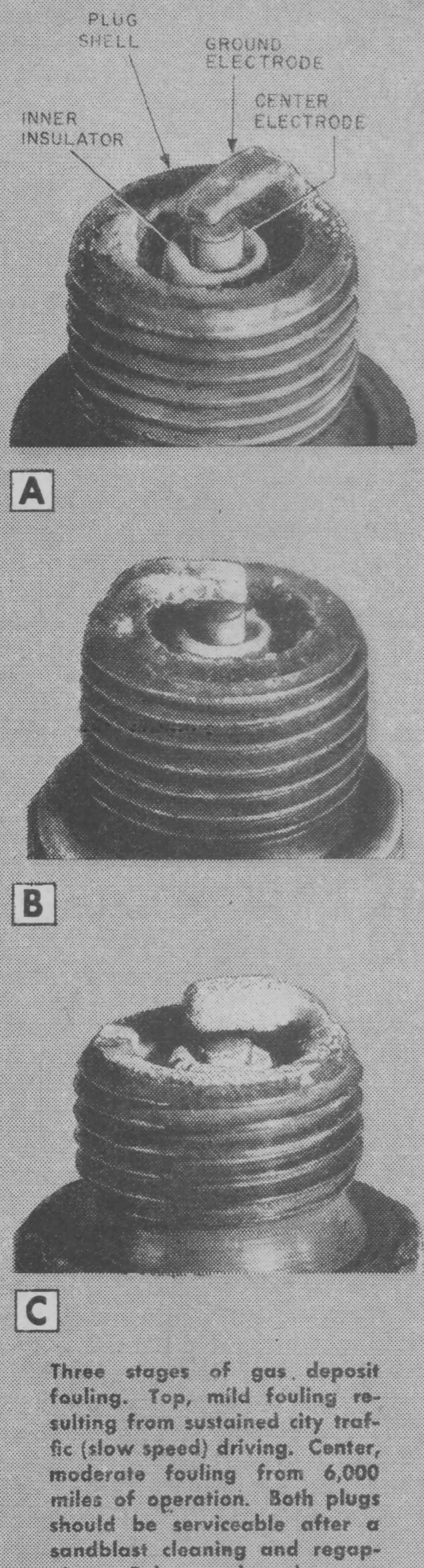
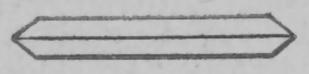
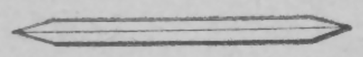


Three stages of gas deposit fouling. Top, mild fouling resulting from sustained city traffic (slow speed) driving. Center, moderate fouling from 6,000 miles of operation. Both plugs should be serviceable after a sandblast cleaning and regapping. Below, what happens after 8,000 miles without cleaning. Deposits are so compacted they would be extremely difficult to remove, and plug should be replaced.

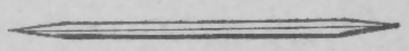
4



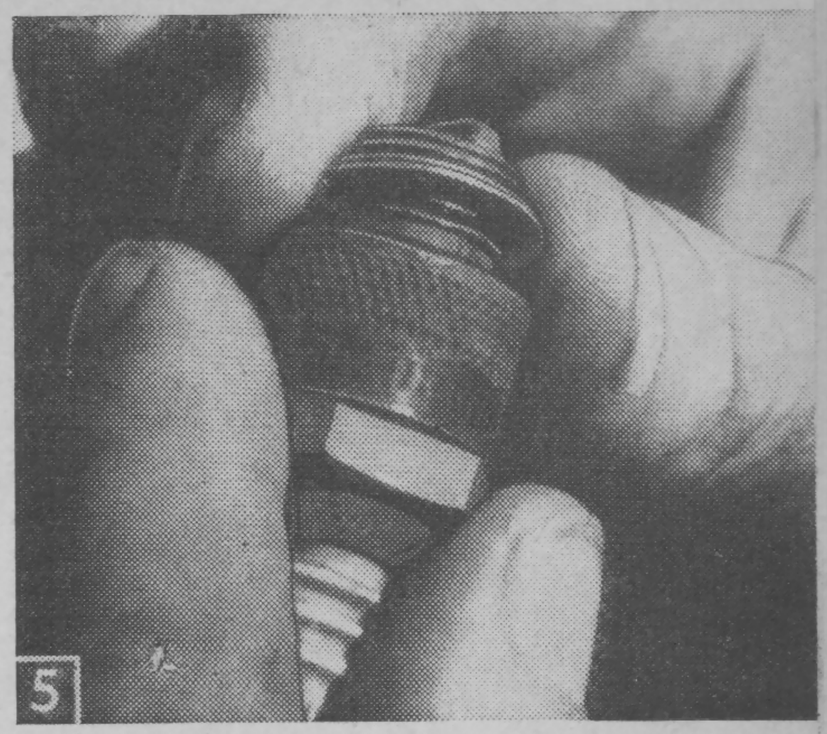
Use new washer if previous one was insufficiently tightened and has appearance of the one above.



Properly tightened washer



Excessively tightened washer flattens out.



5

Checking condition of gasket washer.

of service attention it has been receiving. Once you learn how to read such clues, you can usually correct the trouble, and avoid some burdensome repair bills.

Before removing a spark plug for inspection, carefully blow any dirt out of the spark plug well. This will keep dirt from falling into the combustion chamber when the plug is taken out. Pull the wires from the spark plug terminals *gently* until the snap fitting comes free (Fig. 1). If you jerk them, you may separate the wire from the terminal connection, and although a broken lead wire isn't visible, it will form a secondary spark gap and eventually burn through the ignition cable, causing electrical failure.

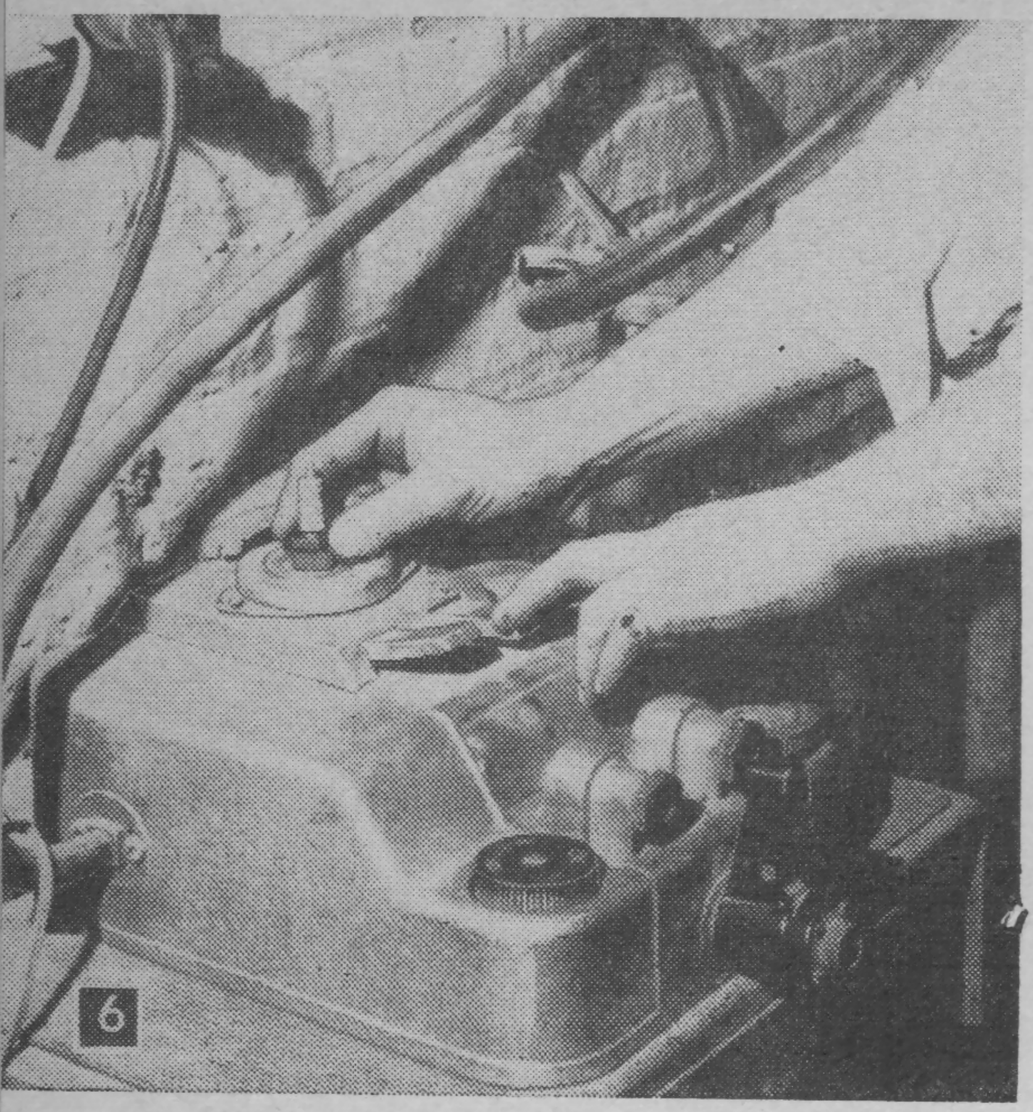
As you remove the plugs, first check each gasket washer (Fig. 5). The surfaces of the washer which contact the plug and cylinder head should be bright, clean, uniform and unbroken. And the washer itself should not be completely flattened.

If the gasket washer is discolored, corroded, or irregularly marked, the plug was not tightened enough during installation. This produces an incomplete seal which allows gases to leak by, and the plug to overheat. And such overheating will cause rapid wear of the electrodes and pre-ignition.

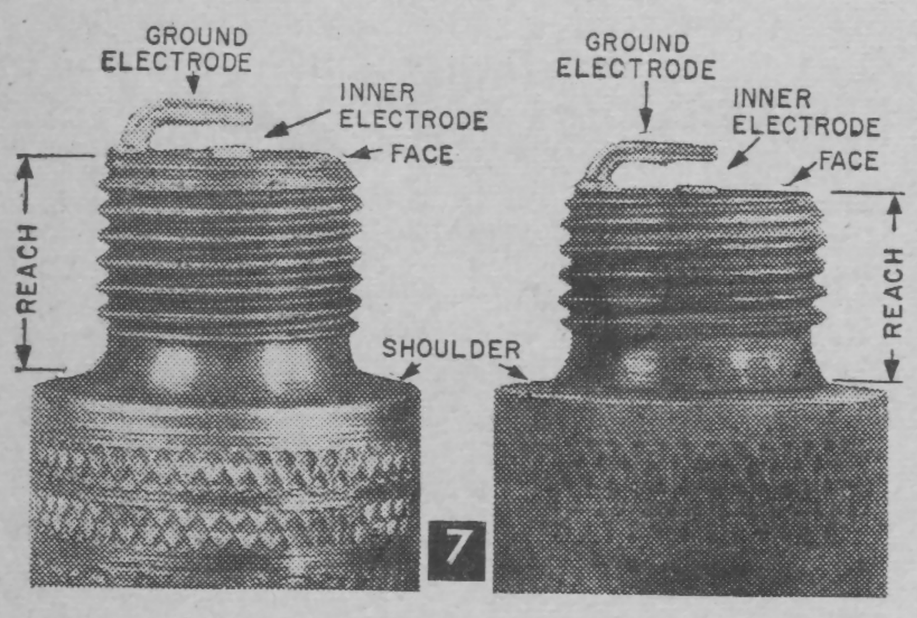
On the other hand, an entirely flattened washer (Fig. 5) means that the plug was tightened too much, and this will often cause a fracture in the plug shell, stretched threads, or a cracked insulator.

Flash Over Versus Corona. When an insulator has been cracked during installation (Fig. 9 right) and this crack fills up with a film of dirt and oil you'll have a condition known as "flash over." Electricity flows directly from the top terminal to the grounded plug shell, completely by-passing the electrodes and spark gap. The plug is thus short circuited, and the only remedy is to replace the plug.

You can also have a "flash over" condition when an accumulation of dirt and oil coats the top insulator enough to allow current to pass through it. The cure here is to wipe the insulator with a cloth moistened with a gasoline or alcohol solvent which will cut the oil film.



Sandblast cleaning a plug—the only good way to remove deposit fouling from inner insulator and inner wall. Most gas stations have such a cleaner and most attendants will let you use it, frequently without charge.



Plug at left is a "long-reach" plug. One at right is of "standard reach."

When "flash over" occurs at the upper insulator, it may be visible in the form of a dim blue *spark discharge* around the plugs. This is sometimes confused with Corona—the *steady blue light* that will appear around the base of the upper insulator, indicating a high tension field. Remember that the Corona blue light is steady, and it will not affect ignition performance. In fact, Corona often repels dust particles and will sometimes leave a telltale clean white ring around the base of the upper insulator, just above the plug shell. Such a ring does not indicate a gas leak between the plug and cylinder head.

Inspecting the Electrodes is your next step. Here you may encounter the examples of fouling or deposit accumulation we mentioned earlier. If the electrodes are covered with a wet oily deposit (Fig. 2), the plugs will probably give you good service after they have been cleaned and regapped. Such deposits are tell-tale signs of oil pumping in the engine, however, and you should check for worn rings, piston and cylinder walls. New rings might cut down the pumping. Or the battery or generator might be ailing to the point where not enough power is being delivered to the plug for proper ignition.

When the electrodes are coated with a hard, baked-on deposit (Fig. 3), it's a sign that too cold a plug is being used in an oil-burning engine. You should change to a hotter plug. If such oil fouling then continues, you'll need an engine overhaul to correct the trouble at its source.

What do we mean by *cold* or *hot* plugs? Well, to function properly, a spark plug must operate within a specific temperature or heat range. So all plugs are classified by heat ranges as well as by size, thread and reach (Fig. 7).

The heat range of a plug is primarily controlled by the length of the center insulator, and is, basically, the speed with which the electrodes will cool after the cylinder fires. The electrodes must remain hot enough to prevent fouling, but must not get so hot that they will ignite the fuel mixture without an electrical spark (pre-ignition).

The problem is that combustion chamber temperatures vary greatly with the type and condition of the engine, how fast it is run and the load it is pulling. For example, when an engine fitted with spark plugs of intermediate heat range is run, at slow (city traffic) speeds for a long time, the electrodes will stay cool enough to allow deposits to form rapidly.

This electrode fouling causes the plugs to misfire, and you get hard starting, poor gas mileage and a loss of power. But when the same plugs are given a high speed workout on the open road, many of the deposits may be burned away, in effect cleaning the plug. So, if you are getting spark plug miss from city driving, take your car out on the open highway and run it hard for an hour or so. Really run it up to peak engine speed and hold it there for a few seconds before you change gears. Such a "hard run" treatment may be the cheapest tune-up you can get.

It helps to clean away the type of fluffy dry carbon deposits in the electrode and inner insulator which are caused by gas-fouling. To prevent a re-occurrence of such rapid fouling, you might—in addition to regular high-speed workouts—lean down the fuel mixture by adjusting the carburetor. Then, if you still get rapid fouling, even after a carburetor adjustment, it might be wise to change to a hotter range of spark plug.

White, Yellow, Brown Deposits. The most com-

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Deposits. The most com-

mon form of deposit fouling results in white, yellow, brown or red coatings on the electrodes (Fig. 4). These are normal by-products of combustion which result from the many additives in today's fuels and lubricants. In their original powdery form, they usually have little effect on spark plug operation. But when high speeds or heavy loads raise the engine temperature enough, such deposits melt and form a glaze coating on the inner insulator. When hot, this glaze is an excellent conductor, and allows the current to follow the glaze instead of jumping the spark gap.

Periodic sandblast cleaning (Fig. 6) usually removes these coatings and restores the plugs to proper operation. If the deposits are compacted between the plug shell and the inner insulator, however, replace the plug. It's almost impossible to remove such compacted deposits without damaging the insulator.

The sandblast treatment, available at most good service stations, is the most effective way to clean the face of the plug and the inner insulator. It won't always remove all the scale and oxide deposits from the center electrode and from the underside of the ground electrode. So, to insure clean firing surfaces, try bending the ground electrode up slightly and cleaning both surfaces thoroughly with a flat distributor-point file (Fig. 8).

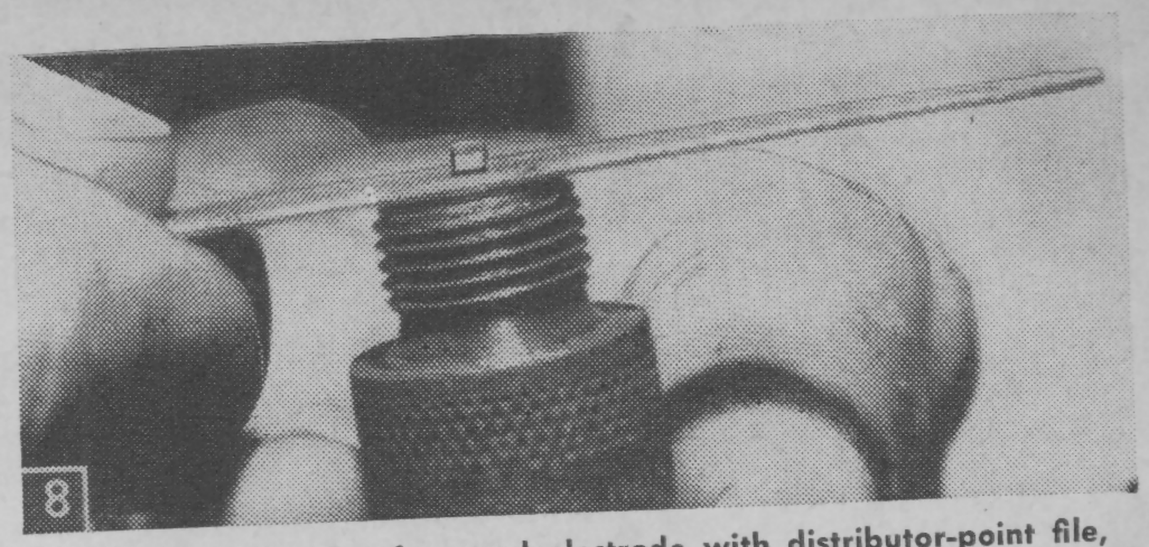
After a cleaning, you frequently discover other faults, such as a broken inner insulator (Fig. 9). This may be caused by carelessness in regapping, or sustained operation with heavy detonation and pre-ignition.

If the lower insulator is cracked and the center electrode worn to a fine point, while the ground electrode shows no sign of wear, the plug is operating too hot. The solution is to discard the damaged plug and replace it with one of a lower heat range.

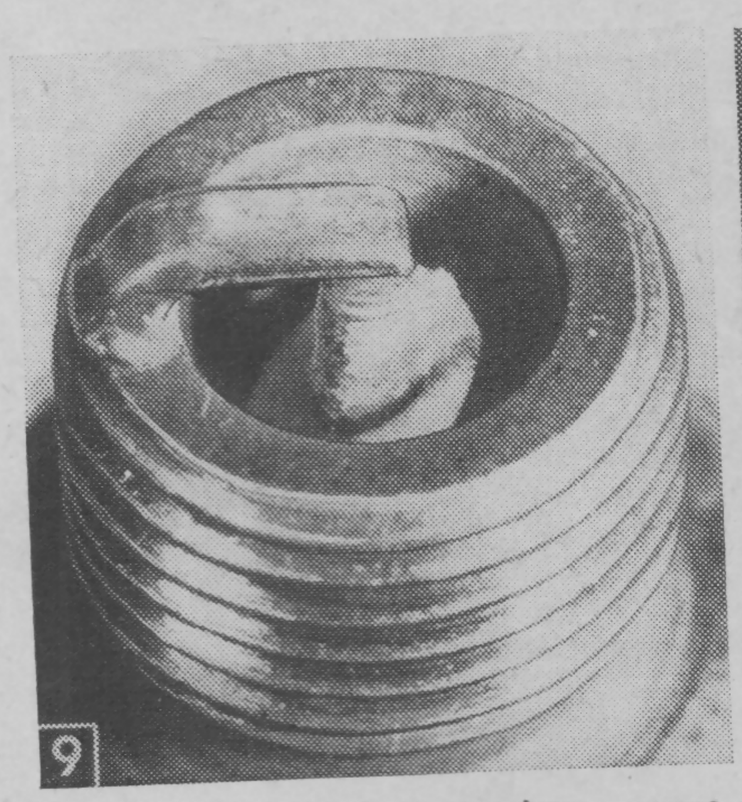
Damaged plug shells are unusual. They are always the result of such mishandling as overtightening during installation. The damage generally shows up as a crack in the threads near the gasket seat, and such a plug should be promptly replaced.

Electrode Wear. Once the fouling deposits have been cleaned off the electrodes, you can check them for wear. As a rough guide, remember that a set of spark plugs, properly cared for and regularly cleaned and regapped, should give you good service for about 10,000 miles. Considering that the spark plug must give off from 1,000 to 3,000 sparks per minute while operating in gas temperatures as high as 4,000° F.—and also withstand explosive pressures of up to 800-lbs/psi—this is a remarkable life expectancy.

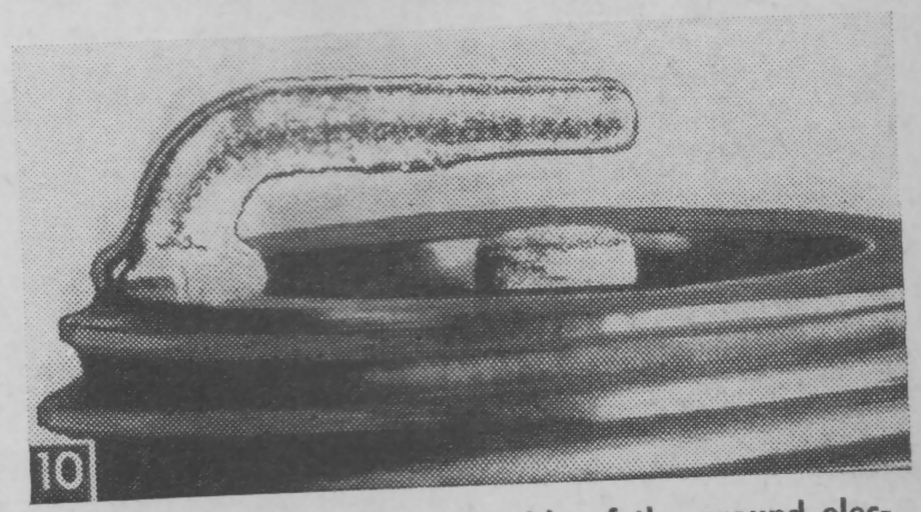
These intense pressures and temperatures, when combined with the corrosive gases in the combustion chamber, gradually wear the electrodes down to the point where the gap can't be effectively reset. Replace such plugs.



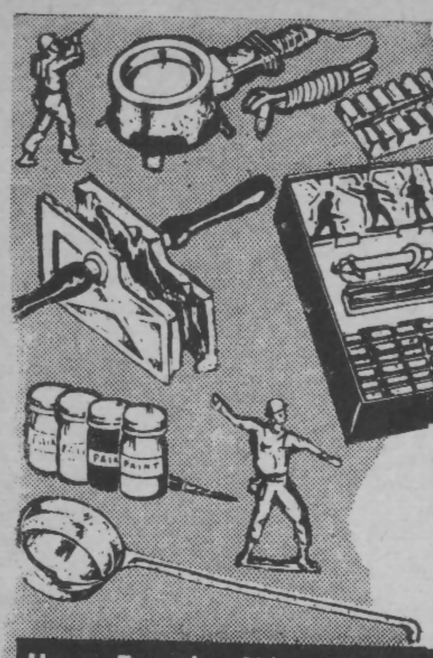
Cleaning underside of ground electrode with distributor-point file, after sandblasting.



At left, a broken inner insulator, a rare condition resulting from center electrode being bent during regapping. Right, cracked upper insulator causes "flash over," and such a plug should be replaced.



Note the wear on the underside of the ground electrode at the tip. This would be normal wear for 4,000-6,000 miles but the plug has only been run 1,000 miles. Suspect faulty installation, too lean a carb mix, an over-advanced spark, a damaged gasket or too hot a range.



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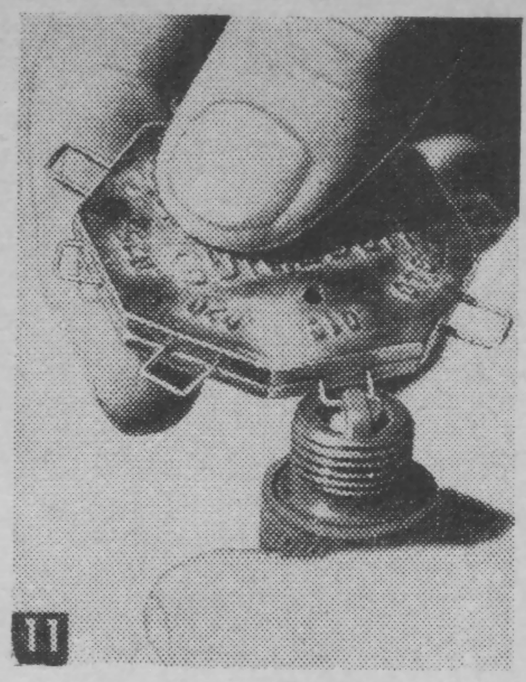

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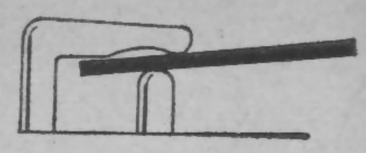
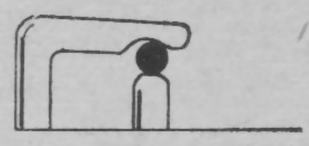
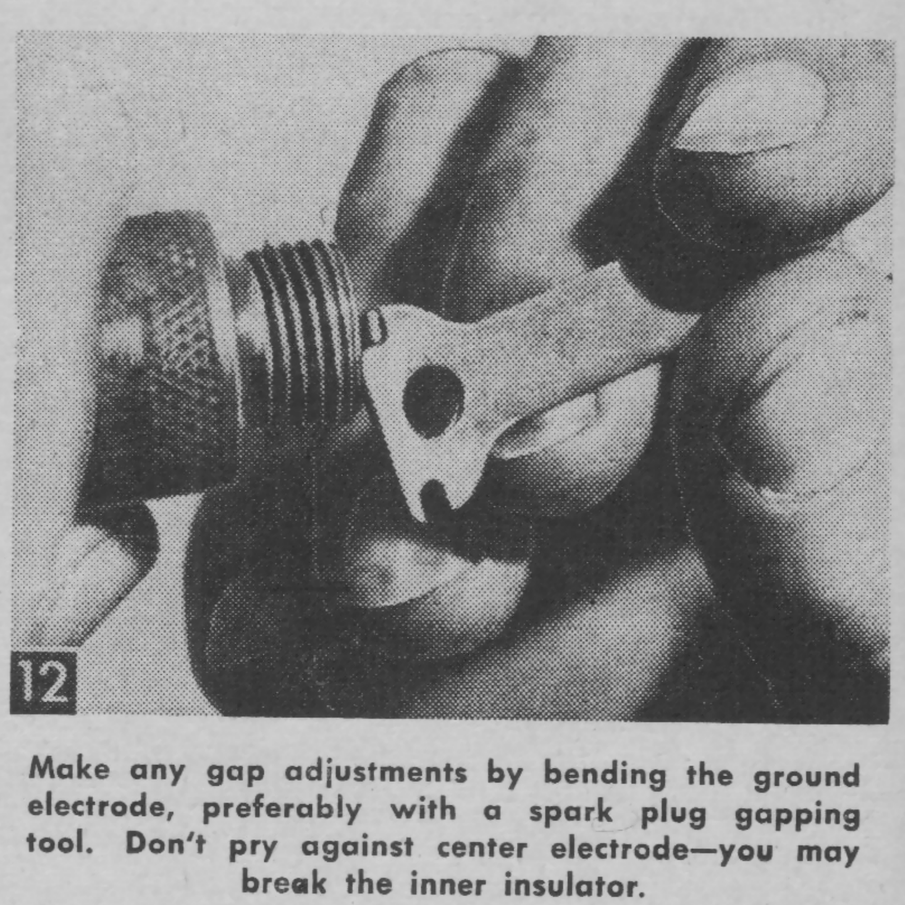


When setting the gap on spark plugs, a flat feeler gage CANNOT give a correct gap reading because of the concave hollow produced by normal electrode wear



ONLY a round wire gage will give an accurate gap reading

Checking spark plug gap to specs given by engine manufacturer. Use round gage, since flat feeler gage cannot give correct gap reading (see inset).



12

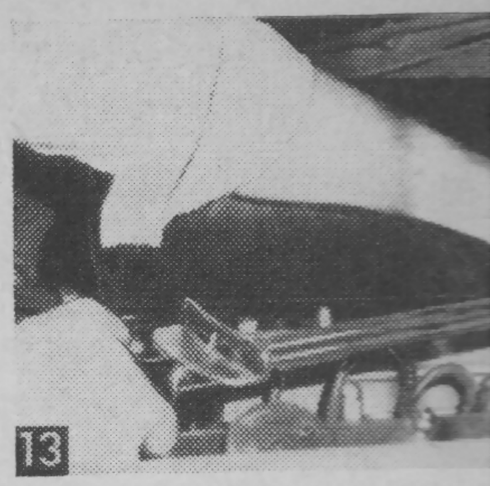
Make any gap adjustments by bending the ground electrode, preferably with a spark plug gapping tool. Don't pry against center electrode—you may break the inner insulator.

When the plug is fairly new, and shows substantial wear, as is the case in Fig. 10, you know that the rate of wear is too rapid. In such cases, the trouble may be faulty installation, too lean a carburetor mixture, an over-advanced spark, dirty or damaged gasket seats, or a plug which has too hot a heat range.

Cleaning and Regapping. A good rule of thumb for spark plug servicing is to remove, clean and regap plugs at least once every 5,000 miles on a new car with less than 30,000 miles on the odometer and about every 2,000 to 3,000 miles on an older car.

Always regap an old plug to the exact specifications set by the engine manufacturer (Fig. 11). If you use a new plug, check it before installing to make sure it also meets the engine specs. Make the gap adjustment by bending the *ground* electrode (Fig. 12). If you bend the center electrode, you'll fracture the inner insulator tip.

Always use a round wire gage (from an



13

Using a torque wrench and proper plug seating. Hand- seats finger-tight, then torqu A. If plugs won't turn by h threads with wire brush a fabric. Then reinstall and t started torquing plugs on mileage te

TABLE A—PLUG SE

PLUG THREAD	CAST IRON
10 mm.	12 ft
14 mm.	25 ft
18 mm.	30 ft
⅞ in.	35 ft
18 mm. taper seat	15 ft

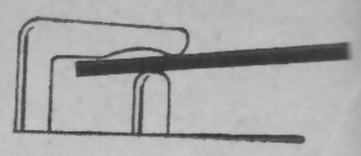
auto supply store) when Because the wearing a tends to form a concave side, a flat feeler gage rate gap measurement

When your plugs ha regapped, *be sure to fit washers before installi* can't give a good seal an tion properly without i

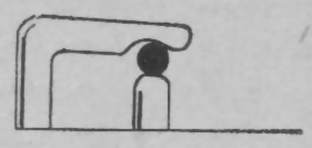
Seating the Plug. The correct seating of the pl wrench for tightening 13). If you own one, a plugs (or can talk y using his) follow wha recommend, as shown i

If you can't torque in the plug in until it sea gasket. Then, using a plug socket wrench, giv turn. This will produc tween the plug and the

Is Your Driving Avera buy a new set of plug manufacturer's chart gi tions for *average* drivin 60% highway). If you lot, covering most of y high speed, you may ne cooler than average. If driver, putting on most city at slow speeds with fic lights, maybe a hott going longer between t



When setting the gap on spark plugs, a flat feeler gage CANNOT give a correct gap reading because of the concave hollow produced by normal electrode wear



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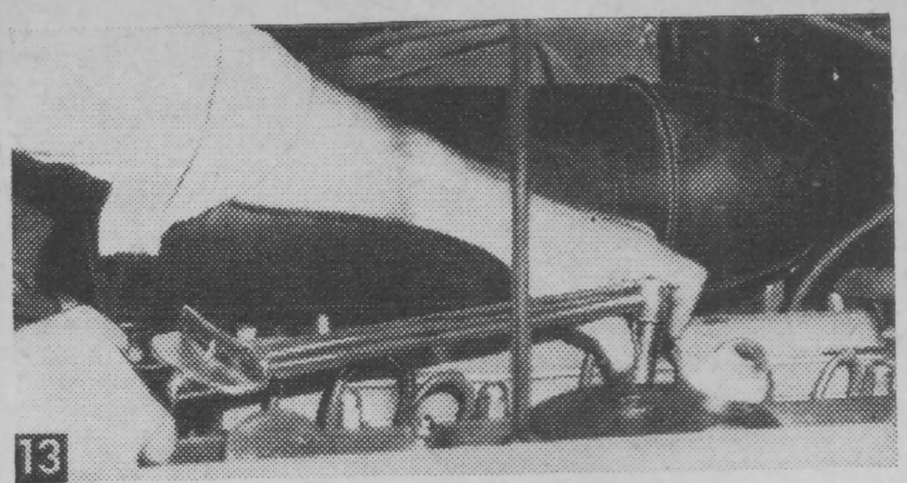

13

Using a torque wrench and deep socket to insure proper plug seating. Hand-thread the plug until it seats finger-tight, then torque in according to Table A. If plugs won't turn by hand, remove and clean threads with wire brush and solvent on a nubbly fabric. Then reinstall and torque in place. When I started torquing plugs on my Porsche, I increased mileage ten times.

TABLE A—PLUG SEATING TORQUES

PLUG THREAD	CAST IRON HEAD	ALUMINUM HEAD
10 mm.	12 ft/lbs.	10 ft/lbs.
14 mm.	25 ft/lbs.	22 ft/lbs.
18 mm.	30 ft/lbs.	25 ft/lbs.
7/8 in.	35 ft/lbs.	30 ft/lbs.
18 mm. taper seat	15 ft/lbs.	12 ft/lbs.

auto supply store) when setting the plug gap. Because the wearing away of the electrode tends to form a concave hollow on the underside, a flat feeler gage cannot give an accurate gap measurement (Fig. 11 inset).

When your plugs have been cleaned and regapped, *be sure to fit them with new gasket washers before installing.* The old washer can't give a good seal and the plug can't function properly without it.

Seating the Plug. The ideal way to insure a correct seating of the plug is to use a torque wrench for tightening down the plugs (Fig. 13). If you own one, and put in your own plugs (or can talk your garage-man into using his) follow what the manufacturers recommend, as shown in Table A.

If you can't torque in your plugs, hand turn the plug in until it seats finger tight on the gasket. Then, using a *proper fitting* spark plug socket wrench, give it an additional ½ turn. This will produce the proper seal between the plug and the cylinder head.

Is Your Driving Average? When you go to buy a new set of plugs, remember that the manufacturer's chart gives the recommendations for *average* driving (about 40% city and 60% highway). If you are on the highway a lot, covering most of your distance at fairly high speed, you may need a plug that's a little cooler than average. If you're a "stop and go" driver, putting on most of your miles in the city at slow speeds with lots of waits at traffic lights, maybe a hotter plug will keep you going longer between tuneups.

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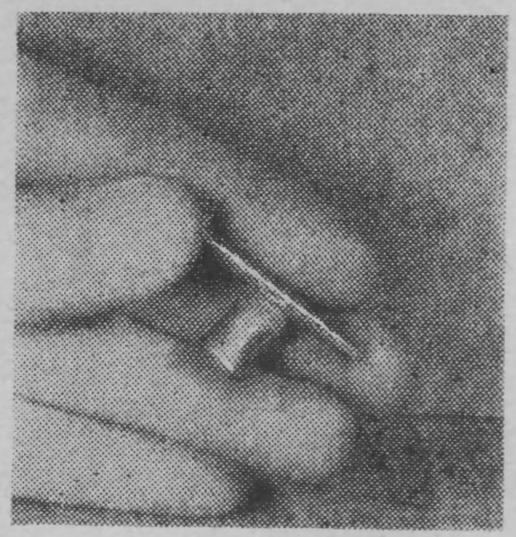


• When a flat tire has been repaired and the innertube replaced on the wheel rim, extreme care must be used to prevent the valve stem from slipping under the rim and out of sight when mounting the tire, necessitating removal of the tire. A brass bolt or rod soldered across the top of a valve cap, which is screwed onto the valve stem before mounting the tire, will prevent stem from slipping into rim and also offer a means of properly lining up the stem.

Pump Sprayer Cleans Engine

• A dirty engine, in addition to being a fire hazard, makes servicing and adjusting difficult. To make the job of engine cleaning quicker and easier, and to get the solvent down into the corners and cracks, spray the cleaning solvent onto the engine with a

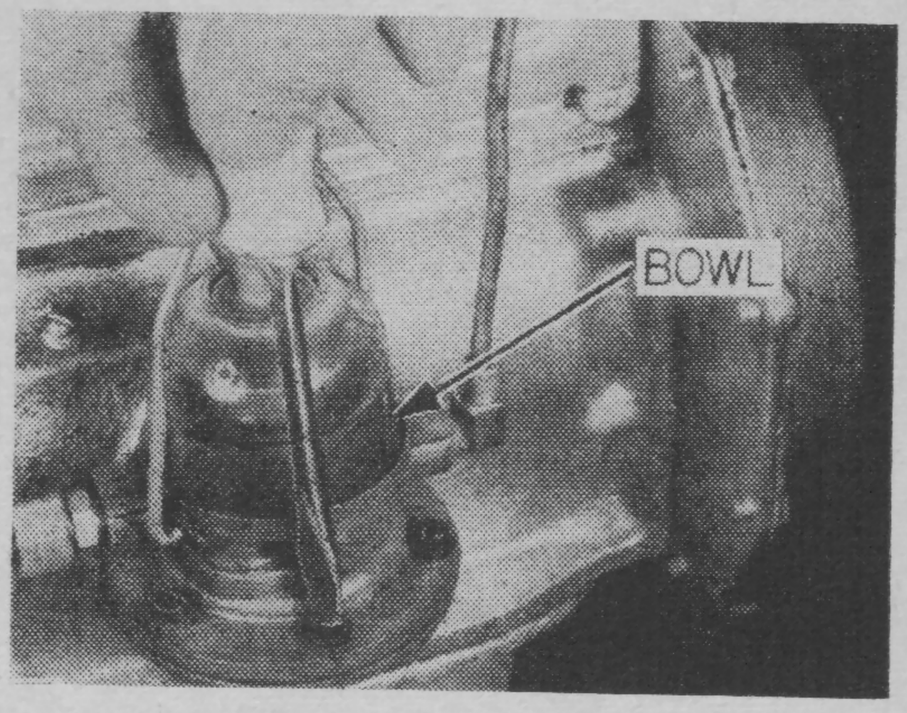
regular pump-type spray rather than applying with a paint brush. Before spraying, cover carburetor and distributor with plastic bags.

Use fireproof solvents such as *Ho-Zof* and *Gunk* and follow the manufacturers' instructions, which usually suggest applying the solvent uniformly on the dirty surfaces and allowing it to act for 15 or 20 minutes, then flushing it off with cold water. Gasoline or kerosene should not be used because of the fire hazard.—M. A. Tidd.

Improving Car Fuel Pump Action

• If you have had to buy a fuel pump every few thousand miles, or your car has lost top speed, or vapor-lock has been a problem recently, the cause may be an air leak between the suction side of the fuel pump and the gasoline tank. Check for this by watching for bubbles in the gasoline in the bowl while the engine idles. Bubbles indicate that the pump is drawing air, possibly because of an air leak bewteen the glass bowl and the pump housing. To remedy this, follow the steps listed below, testing after each so that if it cures the trouble you need not continue the treatment.

1. Tighten down on the hold-down nut; 2. Install a new gasket between the glass and



the metal (5¢ at most auto accessory stores); 3. Tighten the screws that hold the two halves of the fuel pump together as above. 4. Tighten each gasoline-line fitting between pump and fuel tank; 5. Check tank-to-pump line for a small hole, due to chafing. Since the pump is constantly sucking on this line, the leak is not noticed as gasoline under the car, but it is noticed as air-bubbles in the fuel. Air in the gasoline interferes with the engine's receiving sufficient fuel for high speed operation, and it aggravates the tendency of the fuel to vaporize before it gets to the carburetor—in other words it kills the engine with vapor lock.—M. A. Tidd.

Brake Fluid Drowns Shackle Squeaks

• Because oil or grease may not be used in the area of rubber bushing at the front and rear of leaf springs, these points are sometimes difficult to quiet. To eliminate an annoying squeak quickly and for long periods, apply some brake fluid to the bushings. The fluid collected while bleeding brakes will do. Use a pressure oil can, cleaned of all traces of oil, or dip a wad of cotton in the fluid and squeeze it over the hard-to-reach bushing.

Liquid
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simple working micro
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Through its liqui
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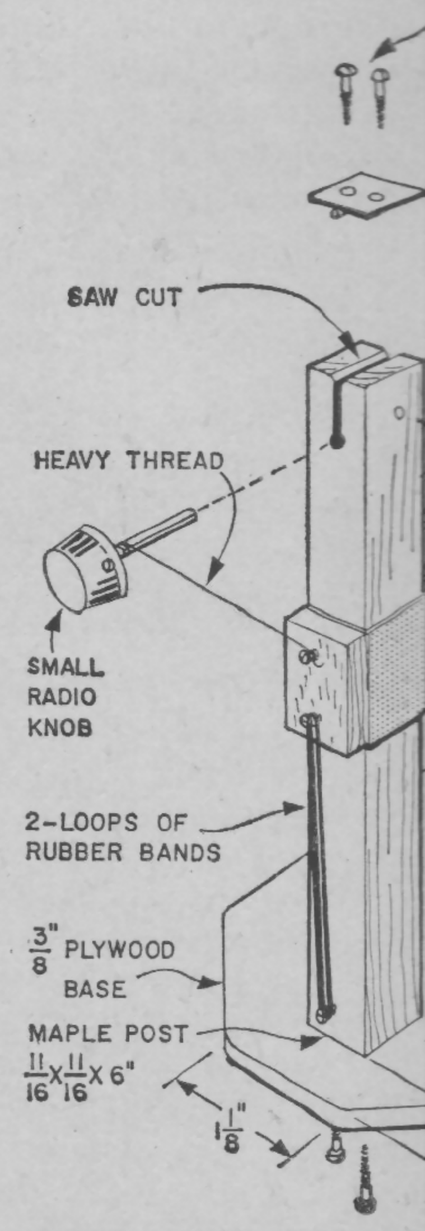

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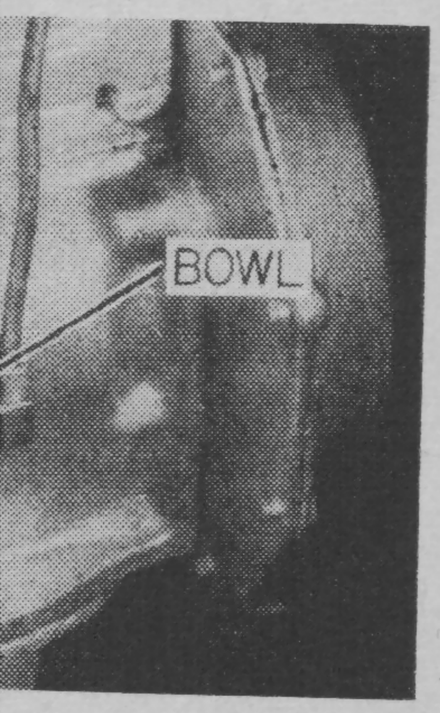

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Shackle Squeaks

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IENCE AND MECHANICS

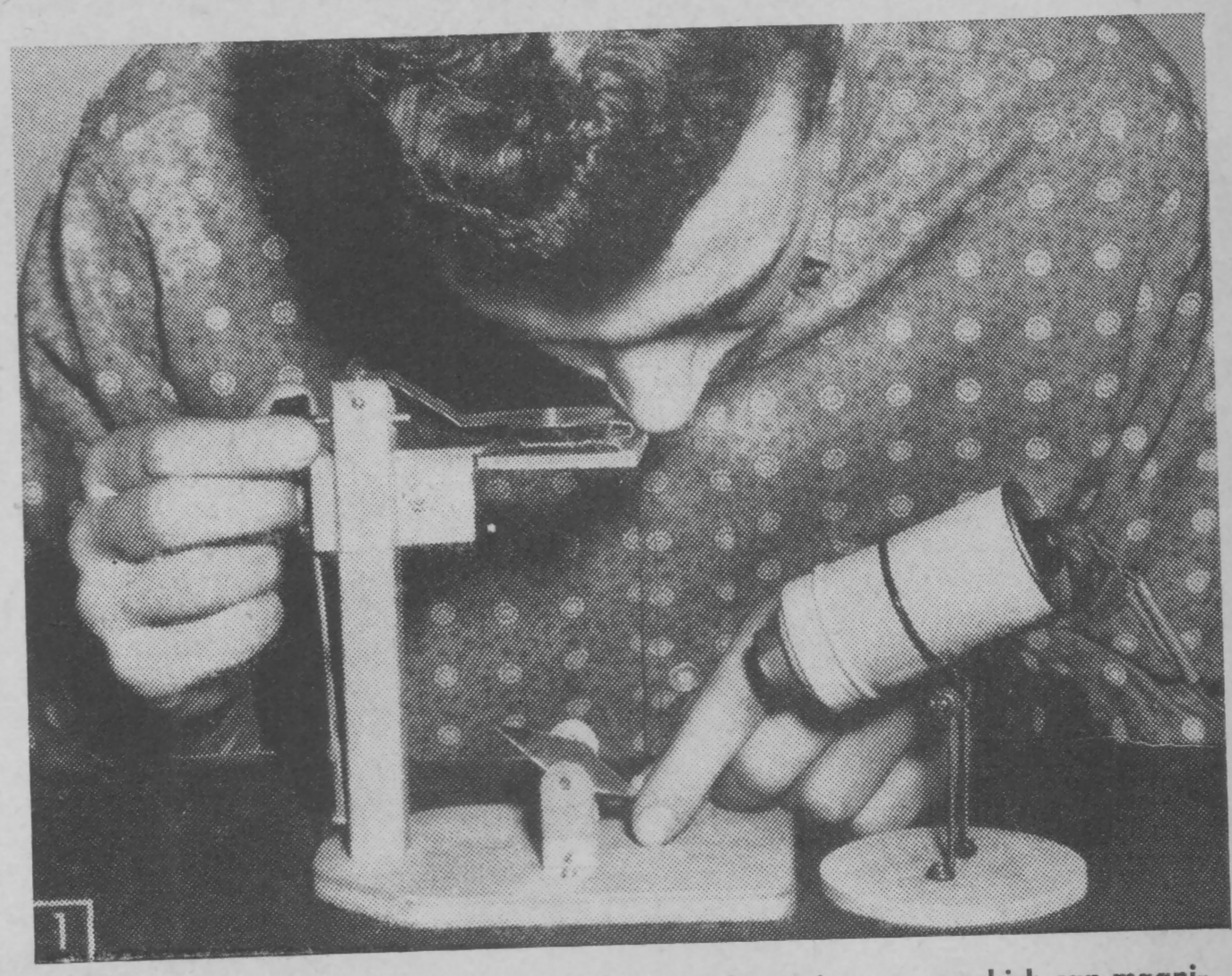
Liquid Lens Microscope for Less Than $1

Everyday SCIENCE

TIN CANS, a rubber band, a ten-cent mirror, a drop of drug store glycerin, some scraps of wood and plastic and a few screws and nuts—all combine to make the simple working microscope shown in Fig. 1.

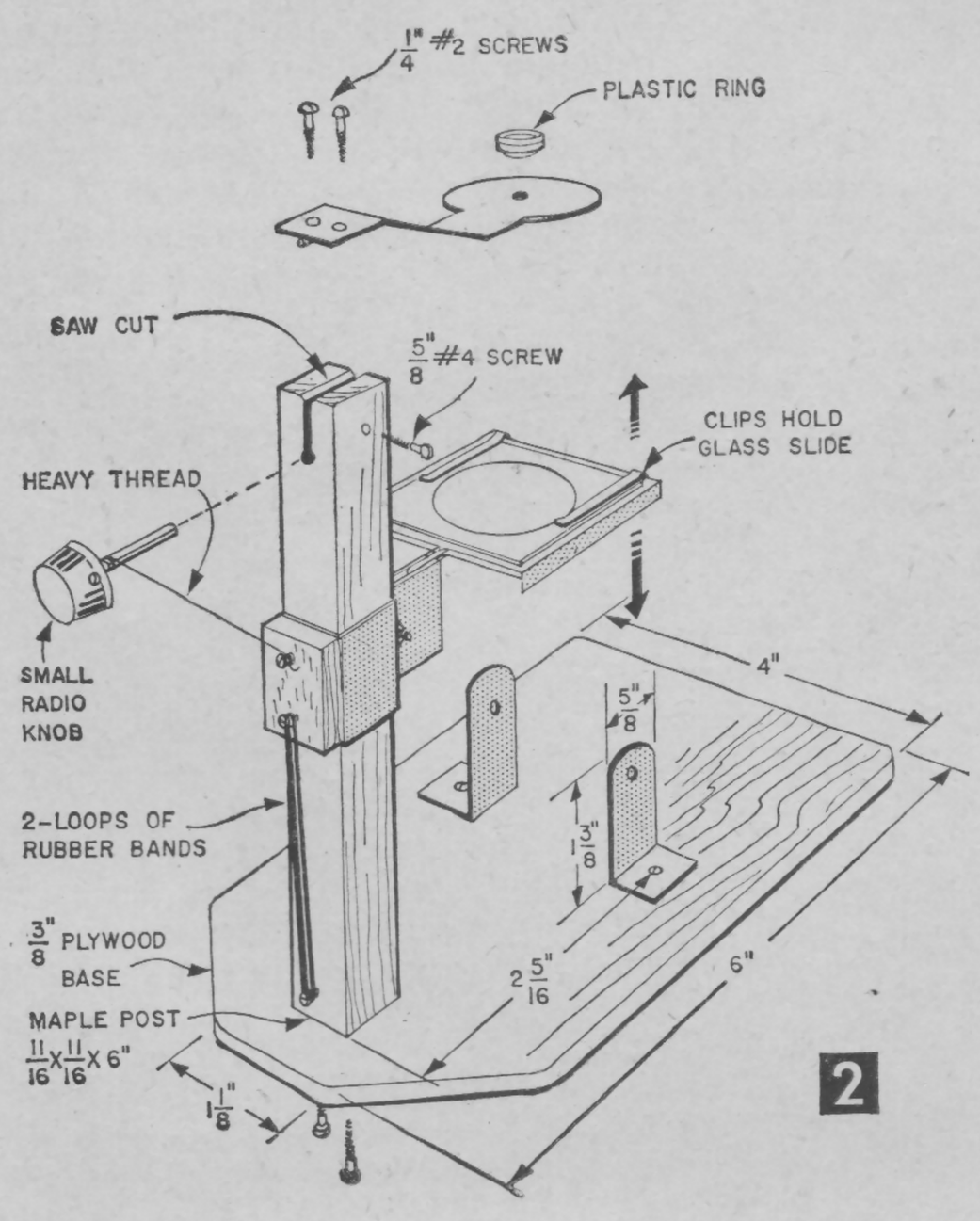
Through its liquid lens you can study such objects as the hairs or spines on the legs of a tiny fruit fly, or the detailed structure of the fly's wings. With some experimenting, you can secure a liquid lens whose magnifying power will approach 100X.

Note in Fig. 2 the simple method for moving the adjustable stage toward or away from the fixed lens, to bring objects in focus. A small radio knob, with part of an 8-penny nail for a shaft, winds up a piece of heavy thread attached to the moving sleeve holding the microscope stage. The rubber band attached to the lower screw on the moving sleeve acts as a spring whose tension produces a force pulling down as the thread is released. This provides a gradual adjustment for bringing the specimen in good focus with the lens. A screw through the slotted top end of the post tightens the hole around the knob shaft as required for the right amount of friction.



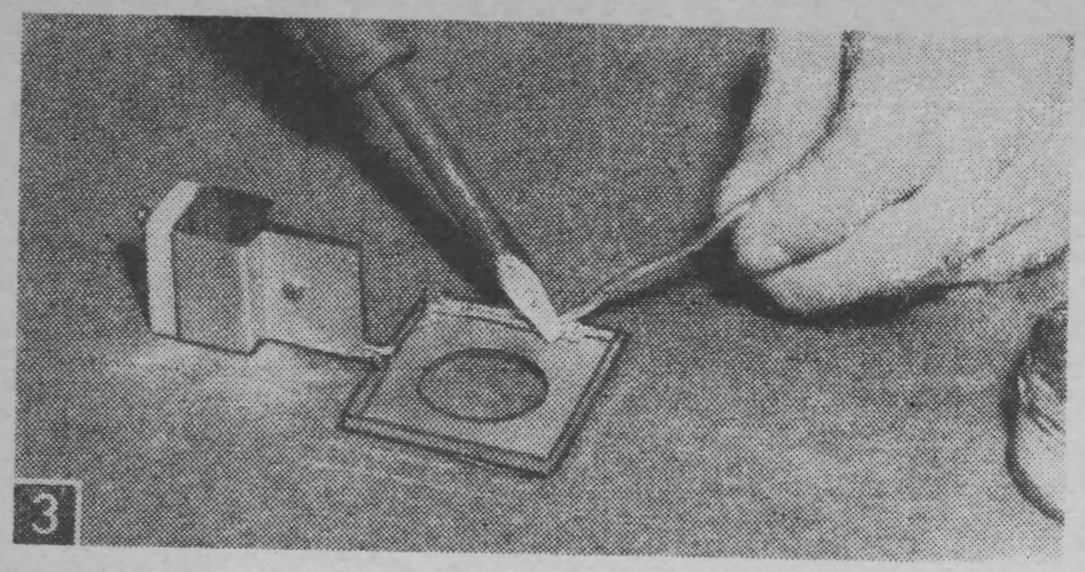
1

Simple liquid-lens microscope, which can magnify up to 100X, has movable stage for focusing.

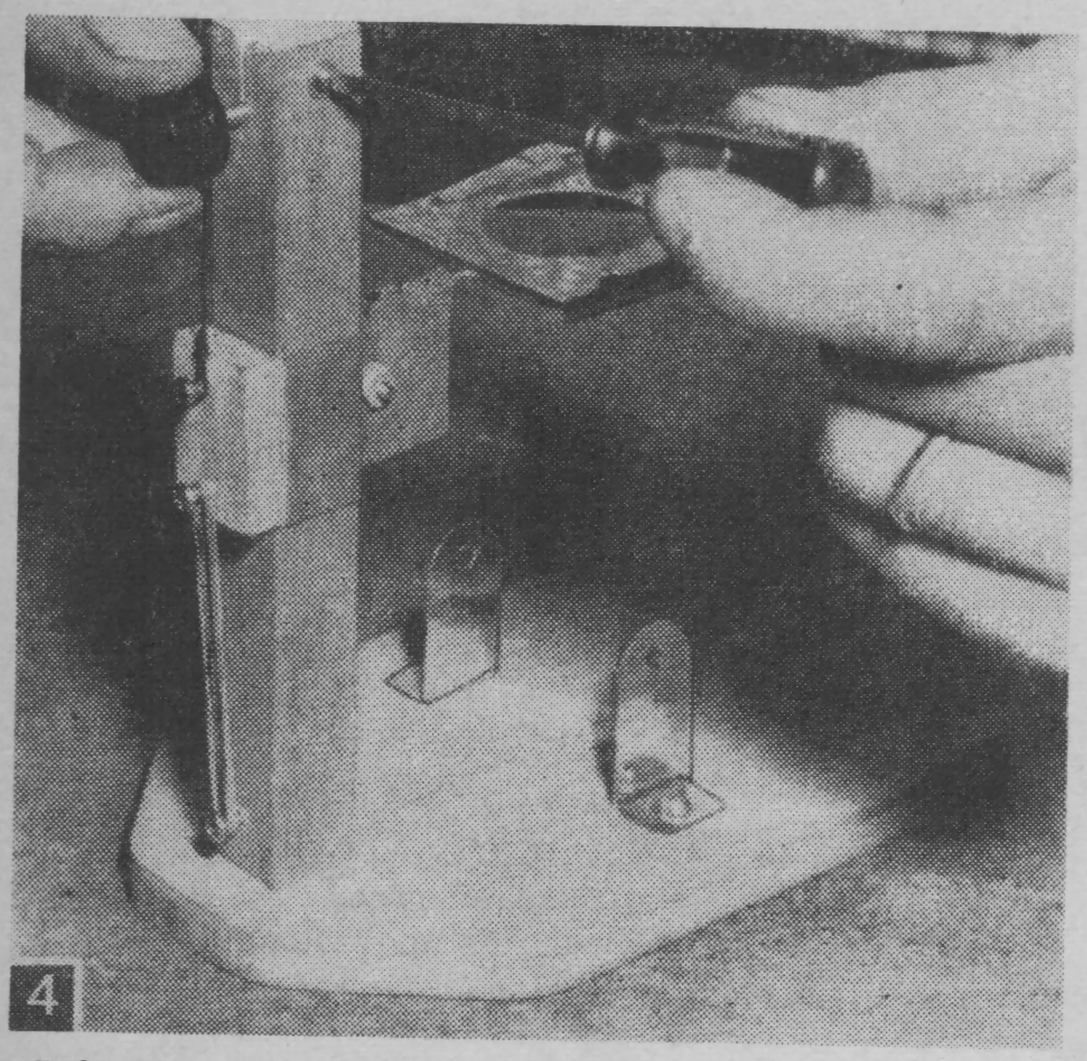


2

Make the base and post assembly as in Fig. 2. Cut out and shape the two tin bracket supports for the mirror, and then attach them to the base. Cut both the stage and lens support arms from tin and solder heavy bare copper wire to the underside of each (Fig. 2) to help stiffen them. Make the 1-in. diameter hole in the stage with a Greenlee



Soldering reinforcing wire to underside of stage.



Tightening tension on knob shaft by drawing slot together with screw.

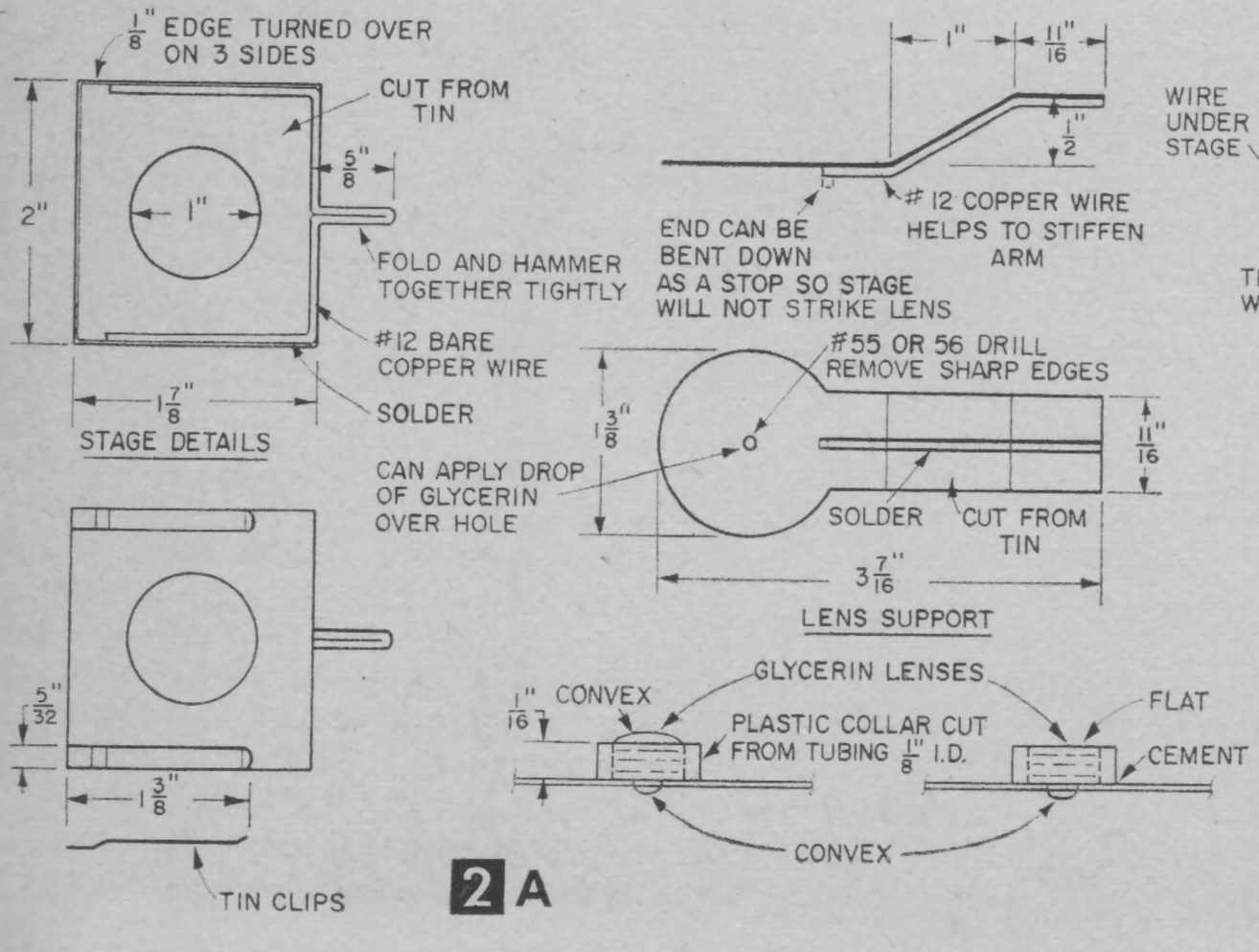
MATERIALS LIST—FLUID LENS MICROSCOPE

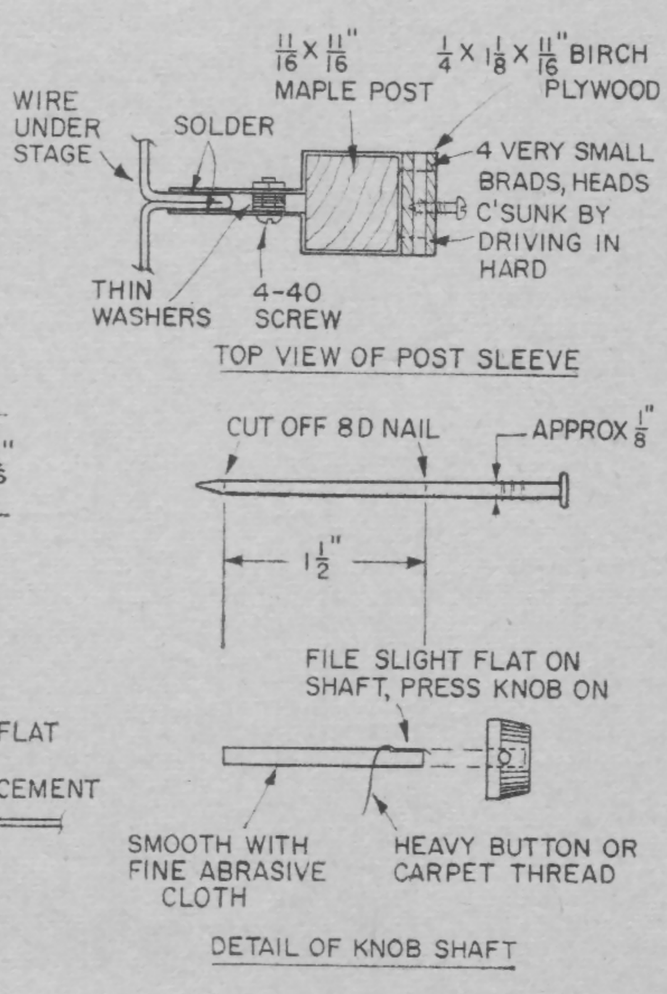
No. Req.	Size and Description
1 pc	birch or gum plywood 3/8 x 4 x 6"
1 pc	maple 11/16 x 11/16 x 6"
1 pc	birch or gum plywood 1/4 x 11/16 x1 1/8"
1	small radio knob with 1/8" hole and set screw (used with transistor radios)
1	8-penny common nail
1 pc	heavy black carpet thread about 4" long
1	rubber band
1 pc	thin mirror 1 1/2 x 1 1/2"
1 pc	thin clear glass 1 1/4 x 2"
1 pc	bare #12 copper wire about 10" long (use under stage and lens support)
1	clean tin can with a tin surface (not the enameled or painted kind)
1 pc	plastic tubing about 1/4" O.D., 1/8-3/32" I.D. and 1/16" long (cut from tubing used with eye drops or other source)
5	*rh* (roundhead) wood screws about 1/4" #4
2	*rh* wood screws 1/4" #2
1	*rh* 4-40 machine screw 5/16 or 3/8" long with nut
6 or 8	thin #4 washers
1	*rh* wood screw about 5/8" #4
4	small brads about 3/16" long
2	*fh* (flathead) #4 wood screws about 3/4"

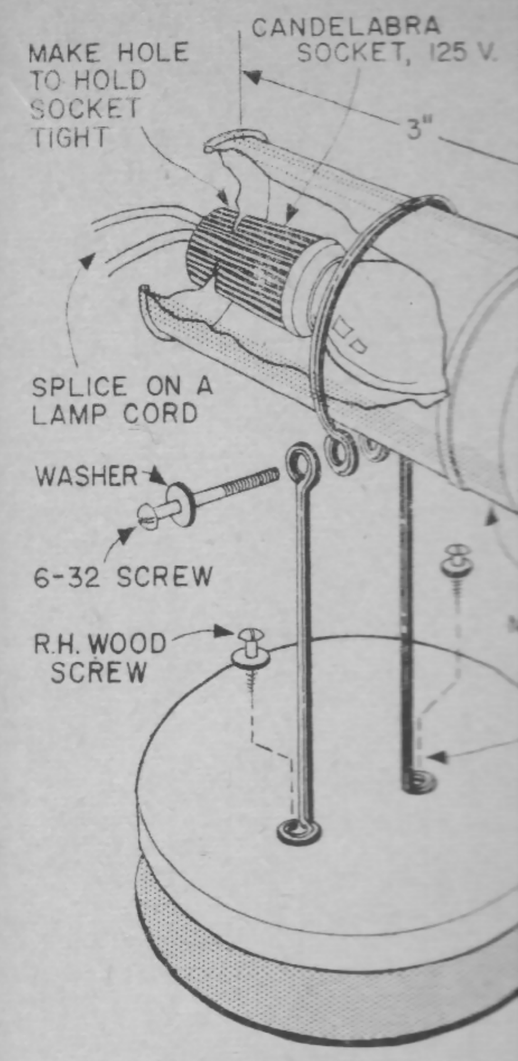
chassis punch, or use a smaller drill and enlarge the hole to size with a half-round file. Cut out and bend the tin clips which hold the glass slide to the stage, and solder these to the stage.

Now test the sleeve assembly on the post for a free fit. Sand the post well, round its corners slightly, and then apply a coat of wax to make the sleeve slide easily.

Figure 4 shows the thread, rubber band and holding screws in place and the knob shaft tension being adjusted, so the thread winds up with reasonable friction of the shaft, but the rubber band will not tend to un-







LAMP DETAILS

MATERIALS LIST—M

No. Req.	Size and Description
1	small round shaker type medicated powders com
1 pc	wood stock 1/4 x 3 1/4 x 3
1	wire coat hanger
1	candelabra lamp socket
1	Christmas tree lamp white
1 pc	lamp cord
1	attachment plug cap
1	screw 6-32 3/4" long with
1	*rh* #4 wood screws 5/16

wind it. Note the V-cut end of the post, to allow wire used with the lens

Attach the lens supp with small wood screws from a piece of plastic was a 1/16-in. section cu from a bottle of eye dro lar around the hole in bond or thin shellac, k metal clear. This make ment with forming lar the lens, as explained l

The mirror (purcha ten cent store) is held the brackets to put te of the mirror; this allo it remains in place for

Use a slide made fro to 1 1/4 x 2 inches. Atta want to examine light center with a trace of ine it, slip the slide u on the stage.

Making the Fluid Lens

a drop or two of glycer pending on the size o

FLUID LENS MICROSCOPE

Description
plywood 3/8 x 4 x 6"
x 11/16 x 6"
plywood 1/4 x 11/16 x1 1/8"
nob with 1/8" hole and set screw
transistor radios)
ion nail
arpet thread about 4" long

1/2 x 1 1/2"
ss 1 1/4 x 2"
pper wire about 10" long (use
and lens support)
with a tin surface (not the
painted kind)
about 1/4" O.D., 1/8-3/32"
1/16" long (cut from tubing
eye drops or other source)
d) wood screws about 1/4" #4
s 1/4" #2
hine screw 5/16 or 3/8" long

ers
about 5/8" #4
out 3/16" long
#4 wood screws about 3/4"

r use a smaller drill
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Cut out and bend the
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ee fit. Sand the post
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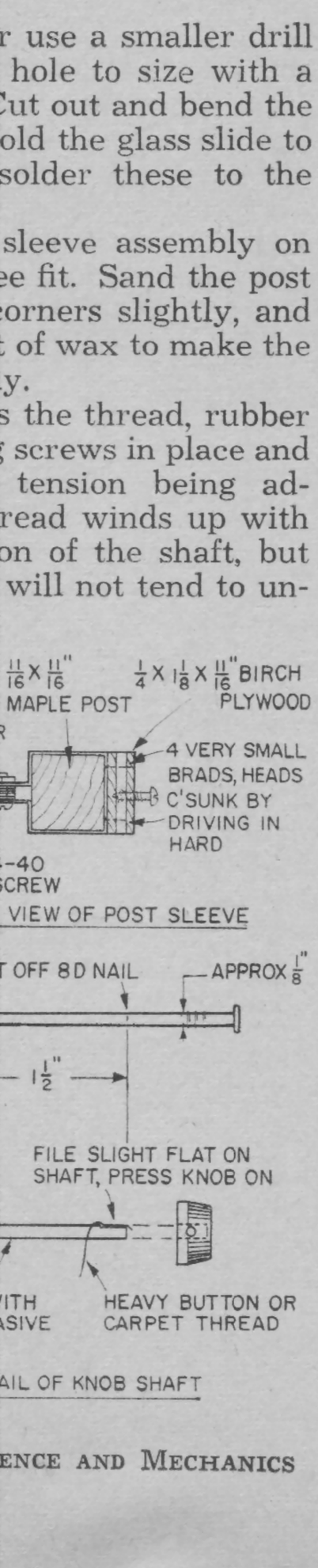

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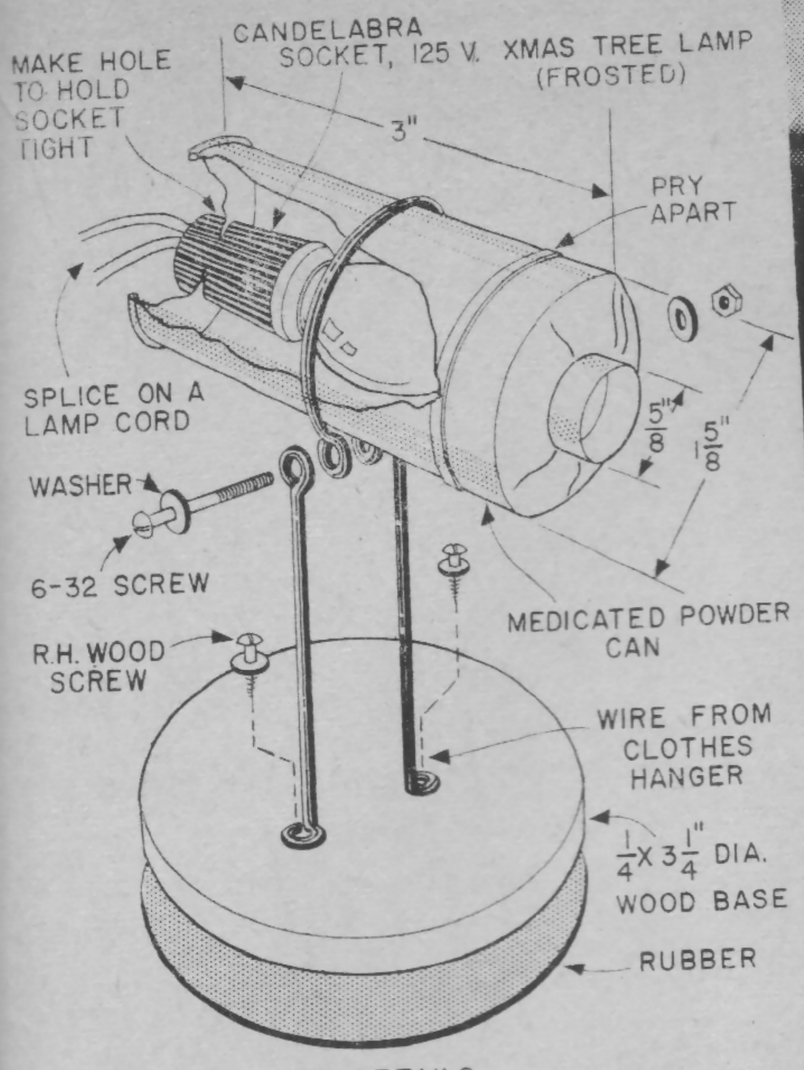


LAMP DETAILS

MATERIALS LIST—MICROSCOPE LAMP

No. Req.	Size and Description
1	small round shaker type medicated powder can such as medicated powders come in
1 pc	wood stock 1/4 x 3 1/4 x 3 1/4"
1	wire coat hanger
1	candelabra lamp socket
1	Christmas tree lamp white frosted 125 volt to fit socket
1 pc	lamp cord
1	attachment plug cap
1	screw 6-32 3/4" long with nut
1	rh #4 wood screws 5/16"

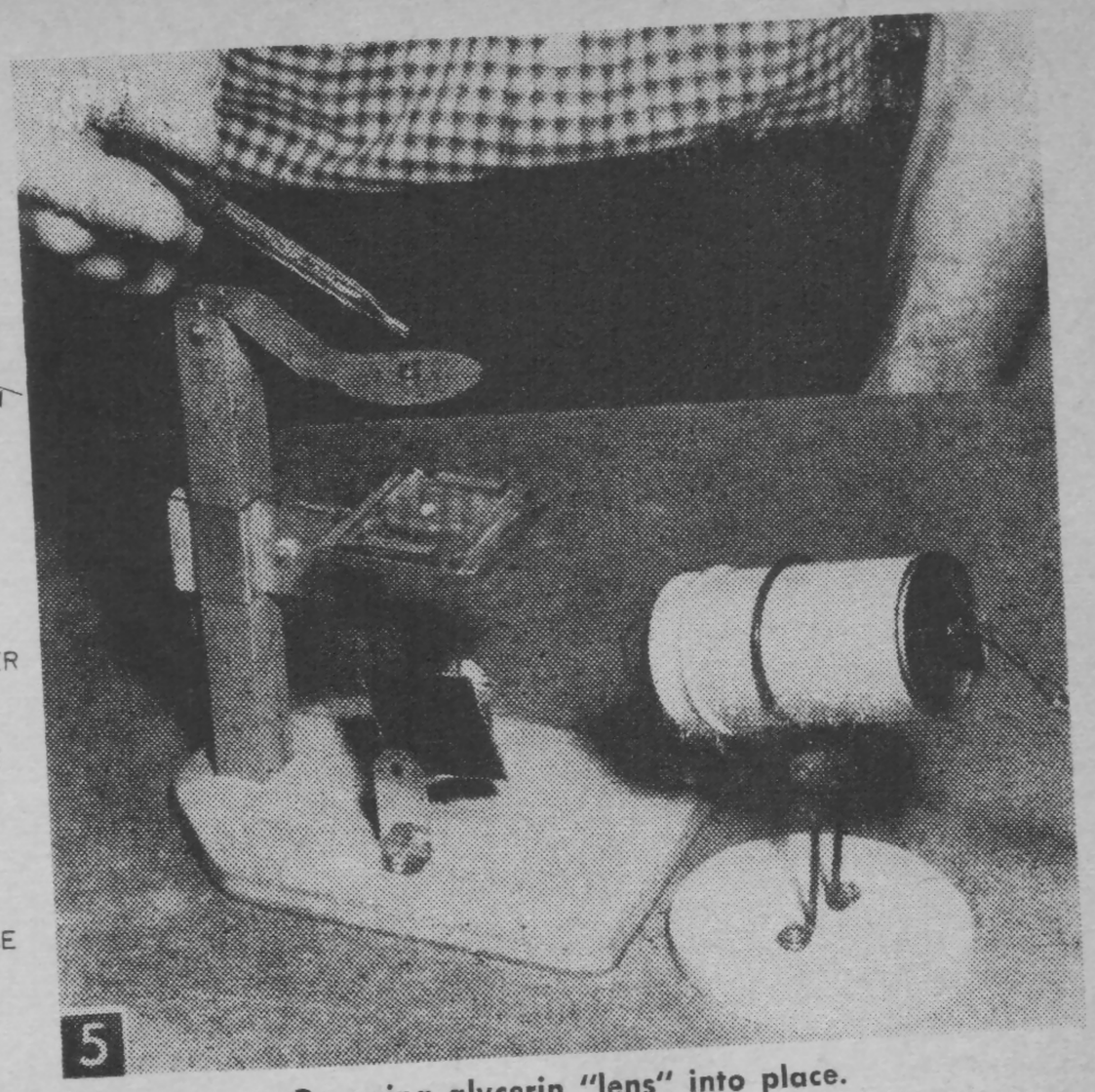
wind it. Note the V-cut in the slot at the top end of the post, to allow clearance for copper wire used with the lens support.

Attach the lens support arm to the post with small wood screws. Make a small collar from a piece of plastic tubing (our "collar" was a 1/16-in. section cut with a razor blade from a bottle of eye drops). Cement this collar around the hole in the metal with Pliobond or thin shellac, keeping the hole in the metal clear. This makes it possible to experiment with forming larger drops of fluid for the lens, as explained later.

The mirror (purchased from an ordinary ten cent store) is held in place by bending the brackets to put tension on the corners of the mirror; this allows it to be tilted, yet it remains in place for any adjustment.

Use a slide made from thin clear glass cut to 1 1/4 x 2 inches. Attach the specimen you want to examine lightly to the slide at the center with a trace of thin shellac. To examine it, slip the slide under the holding clips on the stage.

Making the Fluid Lens. Figure 5 shows how a drop or two of glycerine or mineral oil (depending on the size of the drop released by



5

Dropping glycerin "lens" into place.

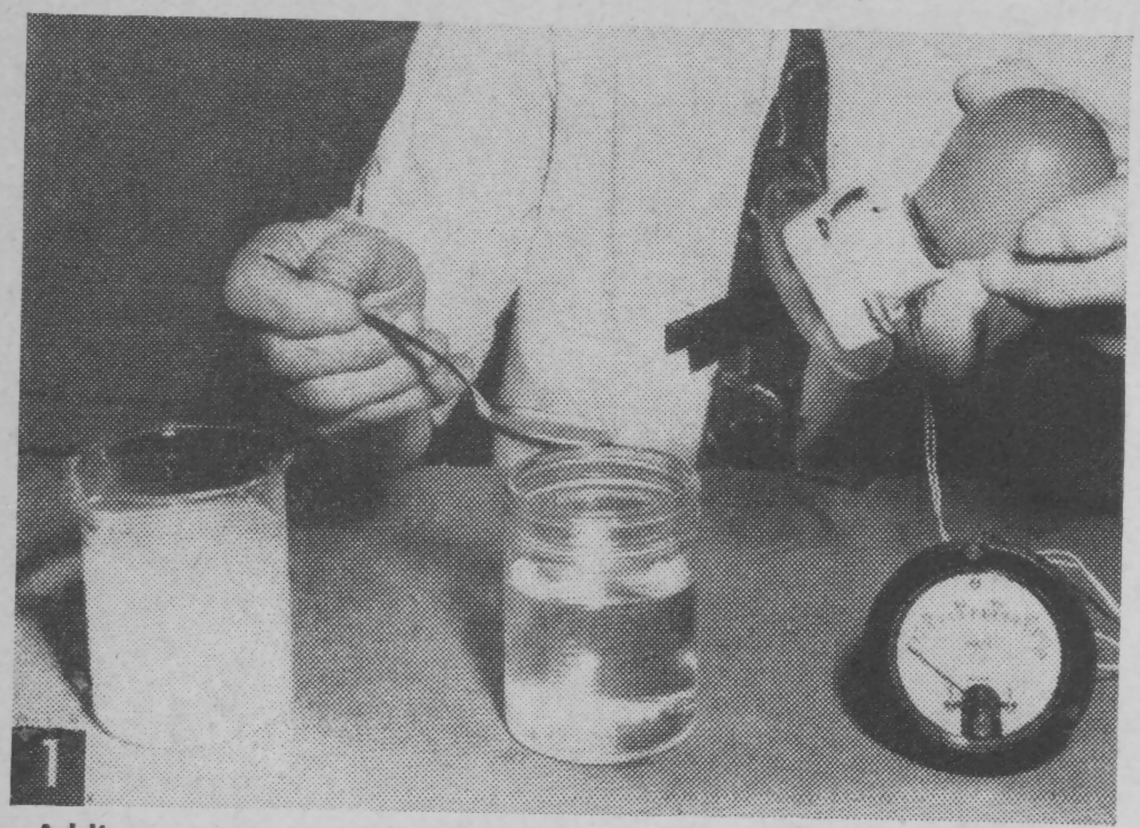
the dropper) is placed in the ring over the hole. If you experiment, you'll find you can form a lens on the ring that is convex on top and after a short time the fluid will come through a bit at the bottom of the hole to form another convex surface.

Another one to try is a plano-convex. This is done by keeping the level of the fluid below the top edge of the ring so the surface will be practically flat. The lower end will gradually bulge down a bit to form a convex surface at that end. Experimenting with the lens, and studying the effect of each change by examining the specimen through it, is the most interesting and instructive part of building this microscope. You'll probably find that glycerine, because it has greater viscosity than oil, will hold its lens shape better.

The focal length will be very short—about 1/16 to 1/4 in. depending on the individual lens. This means you have to raise the stage until the specimen is about this distance from the lens. Make the final adjustment with the knob very gradually as the focus is critical. You can move the slide around a little to examine various parts of the specimen.

For good lighting, use a small lamp that reflects on the mirror up to the underside of the slide. The lamp shown in Figs. 5 and 6 was made from a small round can which had contained medicated powder. Pry off the top section and make a hole in the bottom for a press-fitted candelabra socket to hold a white frosted, 115-volt Christmas tree lamp. Make the adjustable support from a wire coat hanger and the base from wood as shown. The front end has a 5/8-in. diameter hole which lets the light out.—Harold P. Strand.

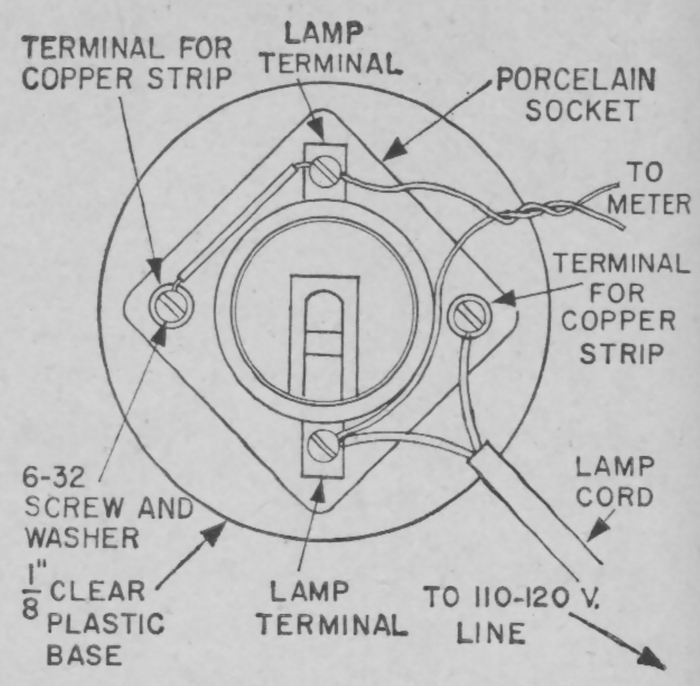
Measuring the Conductivity of Liquids

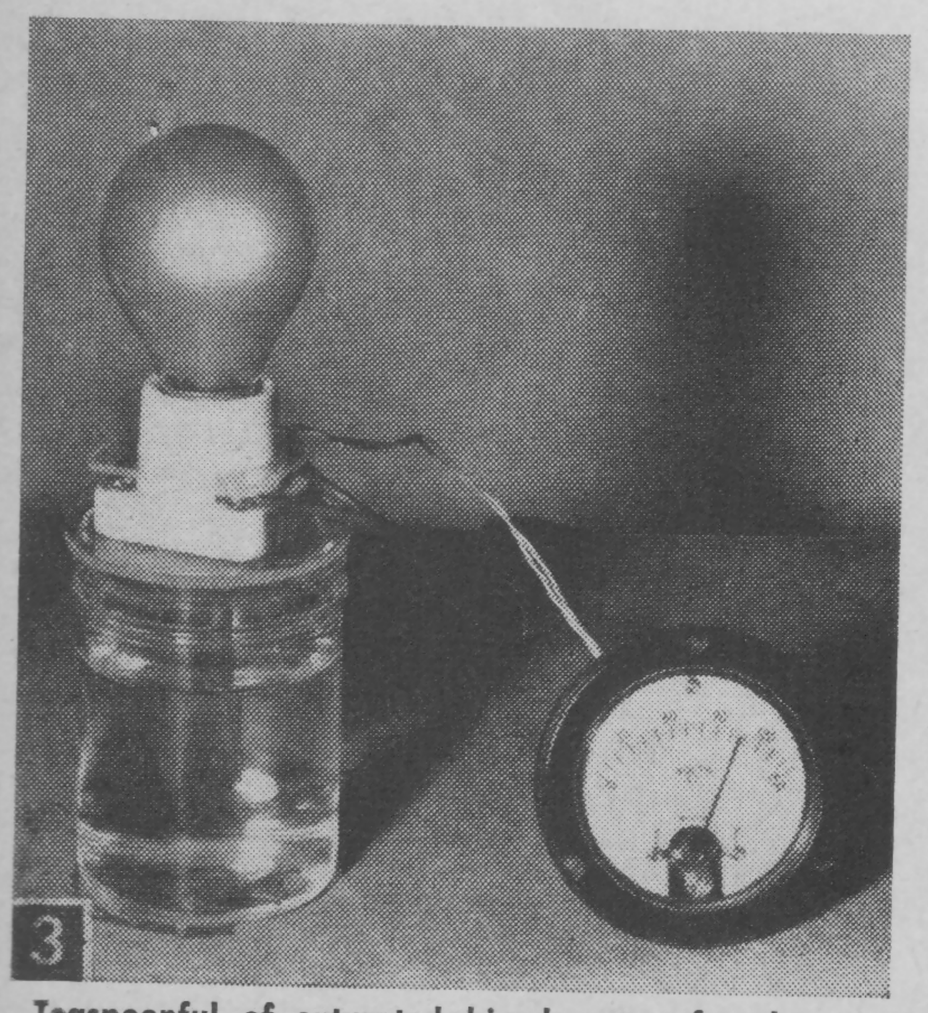


Adding a teaspoonful of saturated solution common salt from beaker at left to test jar of water, upped voltmeter reading from 10 to 112.

SOME liquids conduct electricity better than others. You can test this fact with the setup shown in Fig. 2. Two strips of sheet copper secured to the underside of a plastic disc are immersed in the liquid to be tested. A meter connected across the lamp terminals indicates voltage applied to the lamp.

With this setup, we found, for example, that the voltmeter registered 10 volts with pure water in the peanut butter jar. We then





Teaspoonful of saturated bicarbonate of soda resolved in a lighted lamp and 108-volt reading.

added one teaspoonful of a saturated solution of common salt to the pure water (Fig. 1). The voltmeter reading jumped up to 112 volts, and the lamp burned brightly. No wonder medical technicians use salt-soaked pads when attaching various types of electrical equipment to the body!

Figure 3 shows an experiment using a teaspoonful of bicarbonate of soda from a saturated solution placed in a fresh jar of water. Here the voltmeter registers 108 volts, as against 112 for salt.

Figure 4 shows how a teaspoon of vinegar results in 58 volts to the lamp, indicating conductivity better than water but not nearly

so high as either salt or

For accurate compari quantity of each additive You'll find salammoniac ride) similar to salt in drops of dilute sulphuric will show a surprising c ductivity to water.

Caution: Do not try an —an inflammable liqu touched off in contact w trodes. Also, don't lea plugged in, or out wh poke around its live t plastic guard ring.—HA

Teaspoonful of vinegar prod

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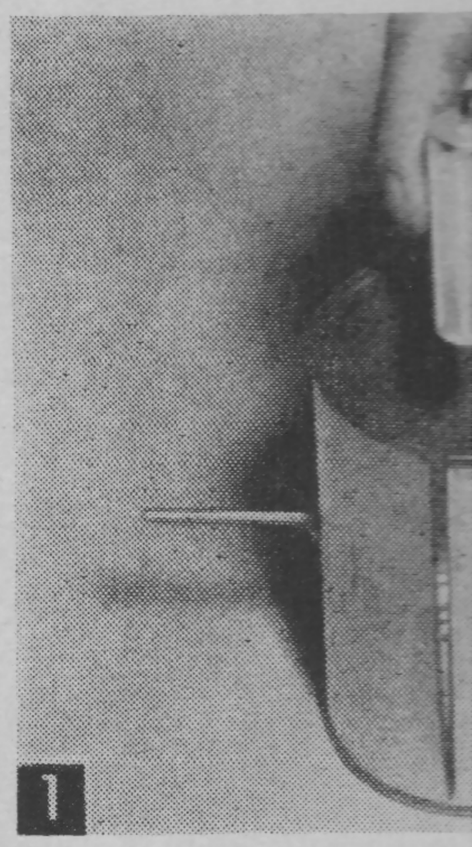

Inside of can to right of s matchstick attached to oth

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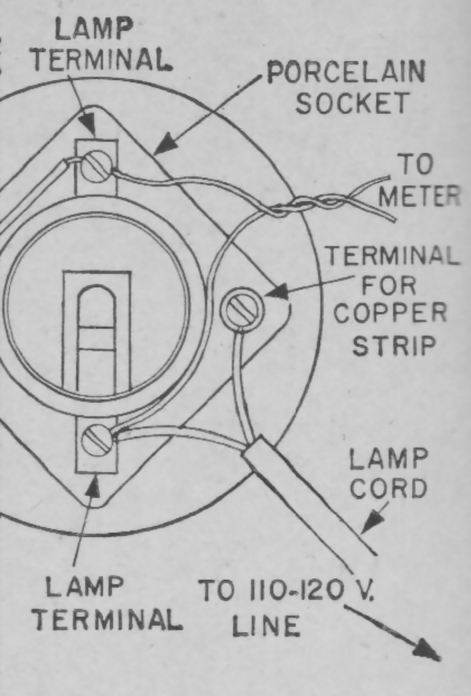
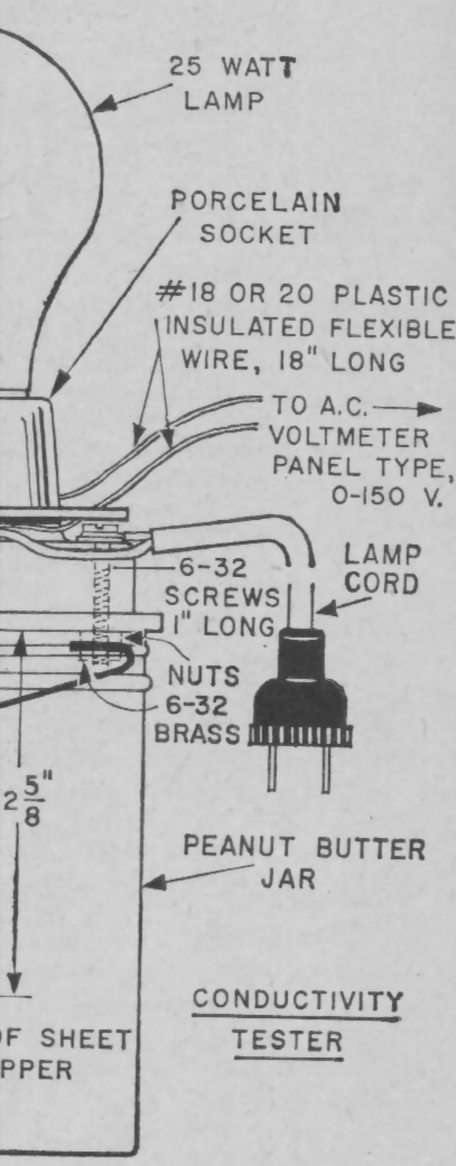
You can demonstra with a tin can. Cut a s sides with tinsmith's s rate the two sides fr coat the inside of one black paint and allow i

Using a lighted cand wax to fall on the o approximate center of cut-off piece of woode wax, holding the stick Next place a candle ab center of the bottom o light it.

You won't have lo

# of Liquids





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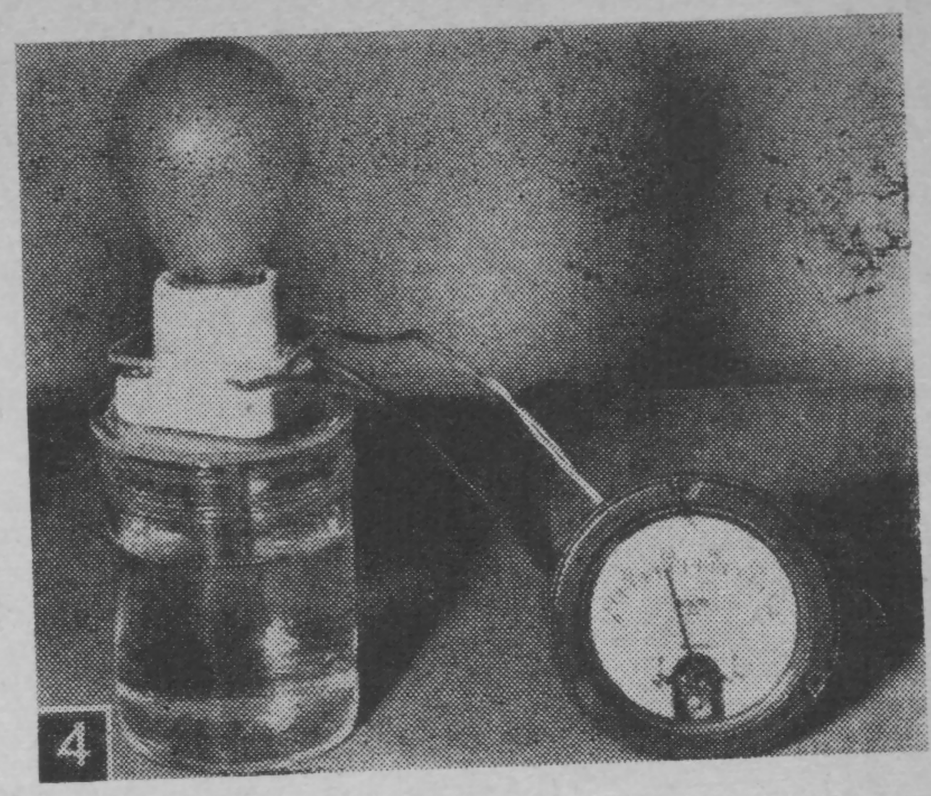
a teaspoon of vinegar
the lamp, indicating
n water but not nearly

so high as either salt or soda.

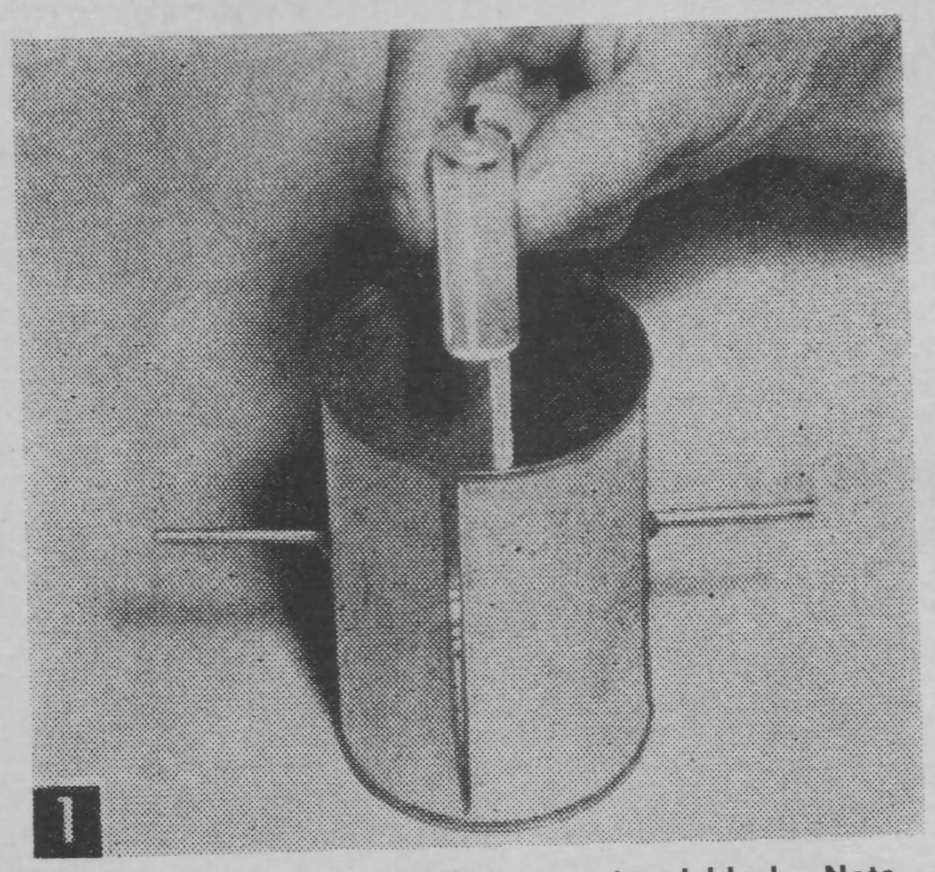
For accurate comparisons, use the same quantity of each additive, e.g. a teaspoonful. You'll find salammoniac (ammonium chloride) similar to salt in conductivity. A few drops of dilute sulphuric acid (battery acid) will show a surprising degree of added conductivity to water.

Caution: Do not try any but aqua solutions —an inflammable liquid could easily be touched off in contact with the copper electrodes. Also, don't leave your test setup plugged in, or out where youngsters can poke around its live terminals under the plastic guard ring.—HAROLD P. STRAND.



Teaspoonful of vinegar produced reading of 58 volts.

Demonstrating Heat Radiation



Inside of can to right of slit is painted black. Note matchstick attached to other side with candle wax.

MOST of you know that dark, rough surfaces tend to absorb heat radiations while smooth, bright surfaces tend to reflect them.

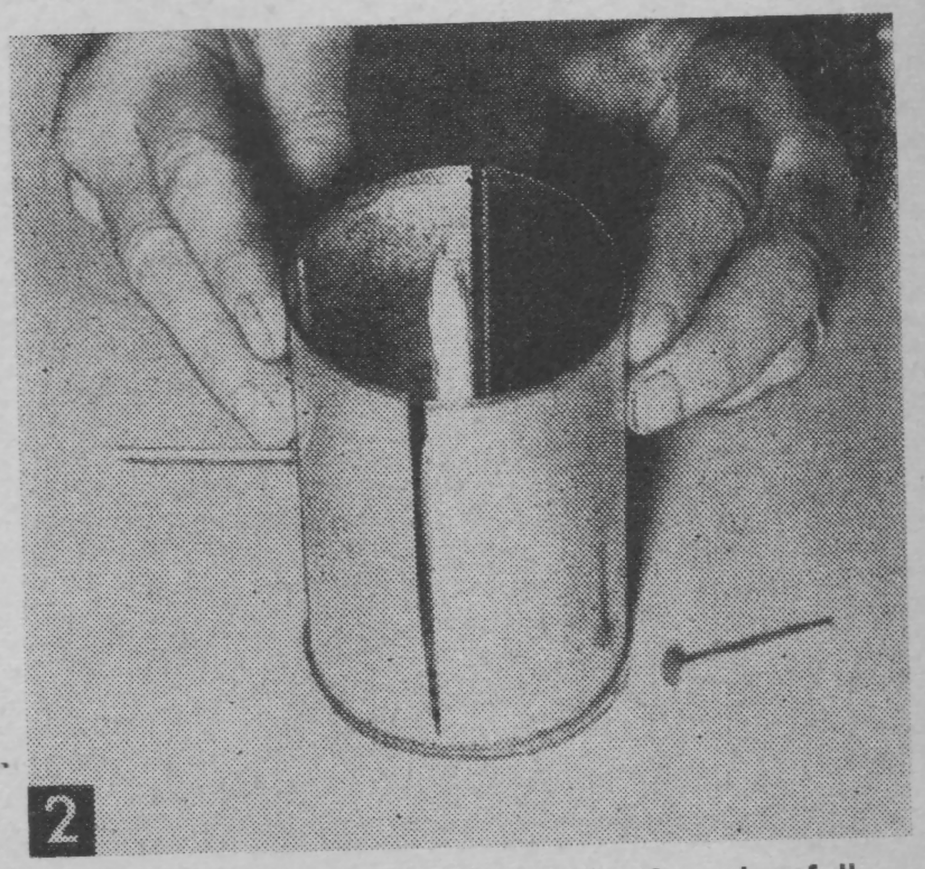
You can demonstrate this dramatically with a tin can. Cut a slot down two opposite sides with tinsmith's shears. This will separate the two sides from each other. Then coat the inside of one of the sides with flat black paint and allow it to dry thoroughly.

Using a lighted candle, allow a drop of hot wax to fall on the outside surface at the approximate center of each side and press a cut-off piece of wooden matchstick into the wax, holding the stick until the wax hardens. Next place a candle about 2½-in. long in the center of the bottom of the can (Fig. 1) and light it.

You won't have long to wait before the stick on the outside of the black side falls off (Fig. 2) when the temperature of the metal at this side melts the wax. The stick on the outside of the unpainted side will remain in place after the first one falls off.

This proves that the blackened surface actually absorbs and radiates heat more quickly than the shiny surface which reflects the heat. In fact you can place your hands on the can, as in Fig. 2, and actually feel the difference in temperature.

Heating engineers often advise against coating heating radiators with aluminum paint for the reasons demonstrated. They may suggest using an oil paint of a rather dark shade and one that dries dull for maximum absorption and radiation of the heat source.—HAROLD P. STRAND.



Matchstick attached to "black" side of can has fallen off while matchstick on shiny side of can remains fixed.

Questions and Answers on Patent Problems

By ALAN MONTAGUE
Patents Editor

BEFORE we begin today's answering session, I want to ask you inventors and would-be inventors a question. Do you think you'll have enough puzzling problems to keep me twice as busy solving them? When this magazine starts coming out every month this Fall, we'll need to know how much space to devote to patents each issue.

So, if you've been holding back some questions, now's the time to send them in to me. And now, suppose we eyeball question number one:

Patenting Endless Tracks?

I have an idea for a new application of endless tracks such as are used on tanks and tractors. Would the new application be patentable? (C. V. S., California)

The broad idea would not be patentable, since the caterpillar tread is very old. However, you show certain control features in your sketch, and a patent on these details might be very valuable. Remember, patents are not granted on purpose or on new applications, but upon new structures, and often very small (but vital) details.

Get a Foreign Patent?

I have a U. S. Patent, and am wondering about taking out foreign patents. In my opinion these are of no value to the individual inventor, but only to international corporations. What's the real poop? (J. C., N. Y.)

You're right as ham gravy with biscuits. Foreign patents are usually just a pain in the purse. Further, since you already have your U. S. papers, the chances are you are over the time limit in most foreign countries, anyhow. Foreign patents are a pain because they are usually subject to progressive, destructive taxation, while royalties, if any, may be paid in blocked currencies.

Attaching Lace

As per information enclosed, I have a new idea for attaching lace to women's garments. Do I need a patent, a copyright, or what? (W. G. L., California)

You need, first, a search of the Patent Office records, since this is patentable if new. Copyright, if any, might be obtainable on the design of the lace, but since different designs could be used, this would be a problem for the manufacturer to whom you sold the idea. This is a promotional idea, and you should get a patent application drawn up (if the search justifies it) and offer it for sale. Even if a patent is finally refused, the promoter could get off to a good start under "Patent Pending."

No Patent Search Needed?

I have been trying, unsuccessfully, to raise funds for making a model and filing a patent application. I don't want to divulge any details of my invention, and I know a patent search is unnecessary, because my idea is radically new. . . . What do I do next? (J. G. K., Ohio)

Either go out and earn some dough, or get off your "top secret" kick and level with somebody who has the bread, man. As to your not needing a patent search, how do *you* know until you try it? In six cases out of 10, a search proves that a "radically new" idea is pathetically old. On the other hand, if the search indicates that you really *do* have something radically new, the favorable report

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Generator is capable of
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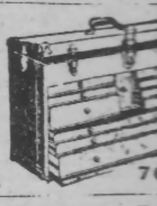
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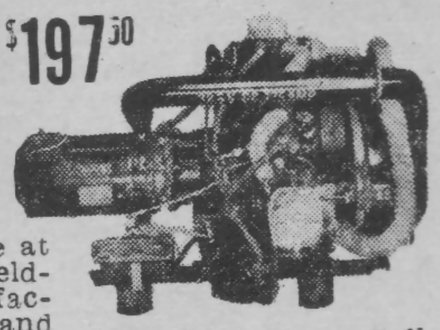

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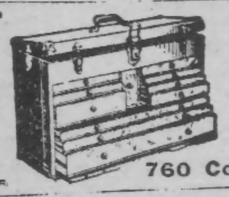

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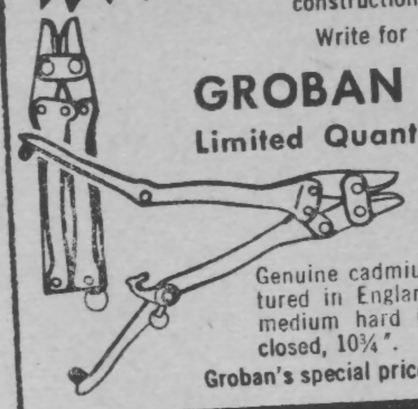

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will be a powerful tool to use in prying money from the pocket of a backer.

Marketing Troubles

Sixty days ago I contacted a big manufacturing outfit, and they were enthusiastic about my invention, but wanted to show it to buyers. Now they won't even answer my letters. What gives? (L. G. S., Virginia)

Looks like they gave up (though sixty days is not very long in the hectic life of a big manufacturing concern). Better forget about them, and contact others, one at a time. Some brokers will sell you a tailor-made list of prospects who are known to be looking for new inventions.

Are Brokers Safe?

Is there any danger in sending unpatented ideas to invention brokers or other firms or individuals? (F. J., Delaware)

There is no danger as far as the brokers are concerned, but it is not wise to send an idea to a prospective buyer unless and until he has invited you to do so, thus setting up —at least by implication—a confidential relationship on which you may be able to sue for damages if he tries any hanky panky.

Abolish Fees and Taxes?

I got a kick out of your article about how some people want to abolish the patent system. I say, why don't they abolish the search fees, and the income taxes on creative work! (T. P., Texas)

I know how you feel. However, with respect to fees for preliminary searches, these are made by strictly private-enterprise searchers who make a profession of it. You are better off with respect both to finances and accuracy of findings to hire one of these men, than you would be if you came to Washington and made the search yourself.

As to the income tax, you can deduct expenses, provided you can show that inventing is your main business. This is tough on the vast majority of independent inventors who have to support themselves, their families, *and* their inventive work out of money earned at another job. Yet, in spite of many protests, the law remains unchanged. All you can do is write to your congressman.

Boss's Rights in Inventions

I am on straight commission; the company doesn't take out any Social Security, so I think I am an independent contractor and not an employee. However, my boss wants to pay for a patent on my invention and exercise "shop rights." If I don't let him, he will most likely fire me. What to do? (Initials and address withheld)

You are probably right that you are not really an employee, but from a practical standpoint, you had better agree with your boss that you are. By following this procedure, he will pay for the patent, do all the model making, tooling up, testing, redesigning, etc., at no cost to you, while you still keep your job. In the end, if the thing works out advantageously, you can quit your job and license the other companies in the industry, leaving your boss to exercise his "shop rights" in his own shop, only. Of course, if he insists on an assignment, then you ought to supplement it with a profit-sharing contract, and for this you need a lawyer. In fact, you need one anyhow.

Promoting the Unpatentable Idea

I enclose an idea which, as you will see, is proably not patentable, since it merely involves packaging an item already sold in bulk, but which ought to sell satisfactorily due to the added convenience. What do I do? (C. G. W., Wisconsin)

To start with, get a patent application drawn up, and then file it when you go on the market, so as to be able to mark your unit "Patent Pending", and throw a chill into would-be competitors. For all you know, you just might get a patent, though it is doubtful. Next, adopt a good trademark and apply for registration. Finally, get an aggressive advertising agency to help you blanket the market as fast as possible, before competition begins to rear its ugly head.

Safe from the Communists?

I have developed an improvement in rocket engines which will vastly increase the thrust. My own government officials will not give me a hearing, stating that their program is mapped out for several years in advance, and, further, that I am probably crazy. Maybe so. Only a working model will tell.

I now think I should apply for a patent in the States and then offer the invention to your government, but if I get the patent it will be published in your Official Gazette, and what is to keep the Communists from using it? (F. J. O., Overseas)

After allowance of the claims, but before issue of the patent, all applications are reviewed by the Patent Office for possible military value. If your invention is of military value, the Commissioner of Patents will withhold your patent from issue (thus preventing publication in the Gazette) and will alert the proper government department. Even before you get your notice of allowance, of course, you can send a copy of the application to the National Inventors Council, and they will alert the proper department at once. If such department decides to use your invention for defense purposes, they will notify the Commissioner of Patents, and by giving him repeat notice once a year, can keep your patent from issuance for an indefinite period of time.

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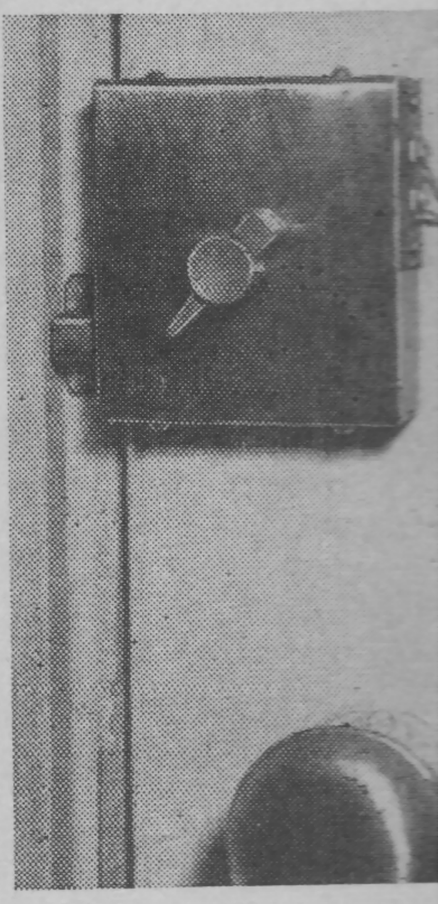

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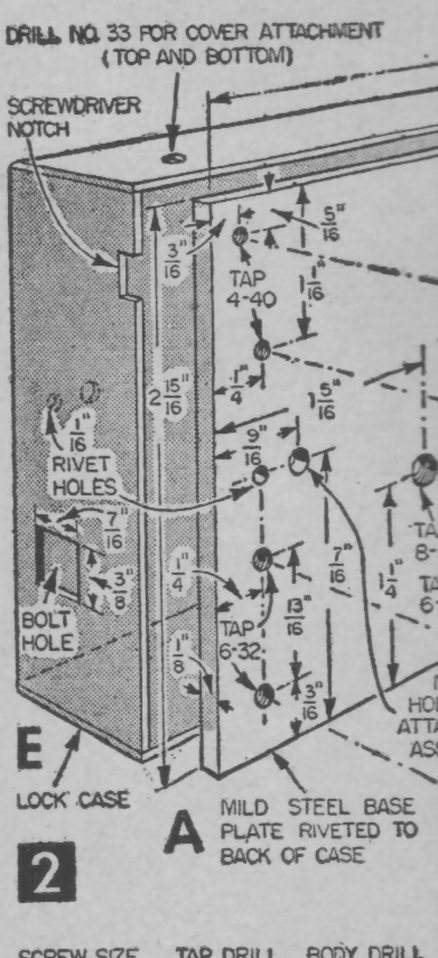

SCREW SIZE.	TAP DRILL	BODY DRILL
4-40	43	31
6-32	36	27
8-32	29	19

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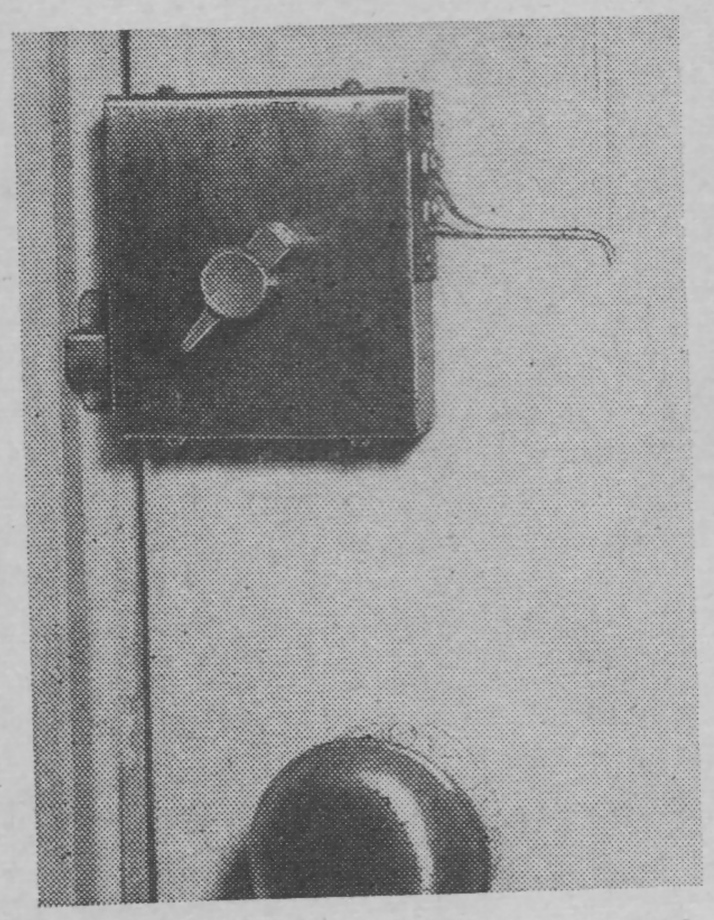
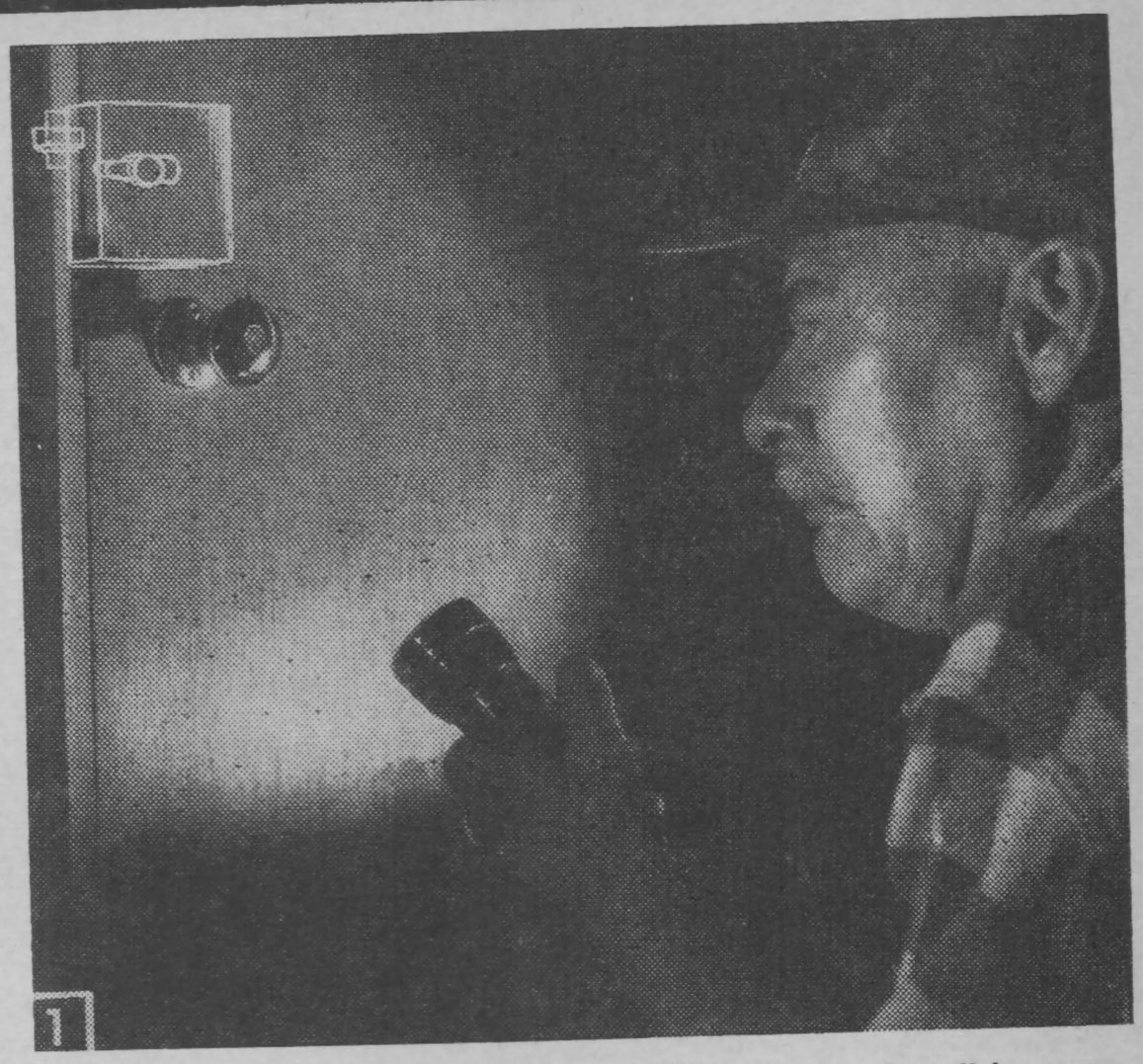
E AND MECHANICS

ELECTRICITY

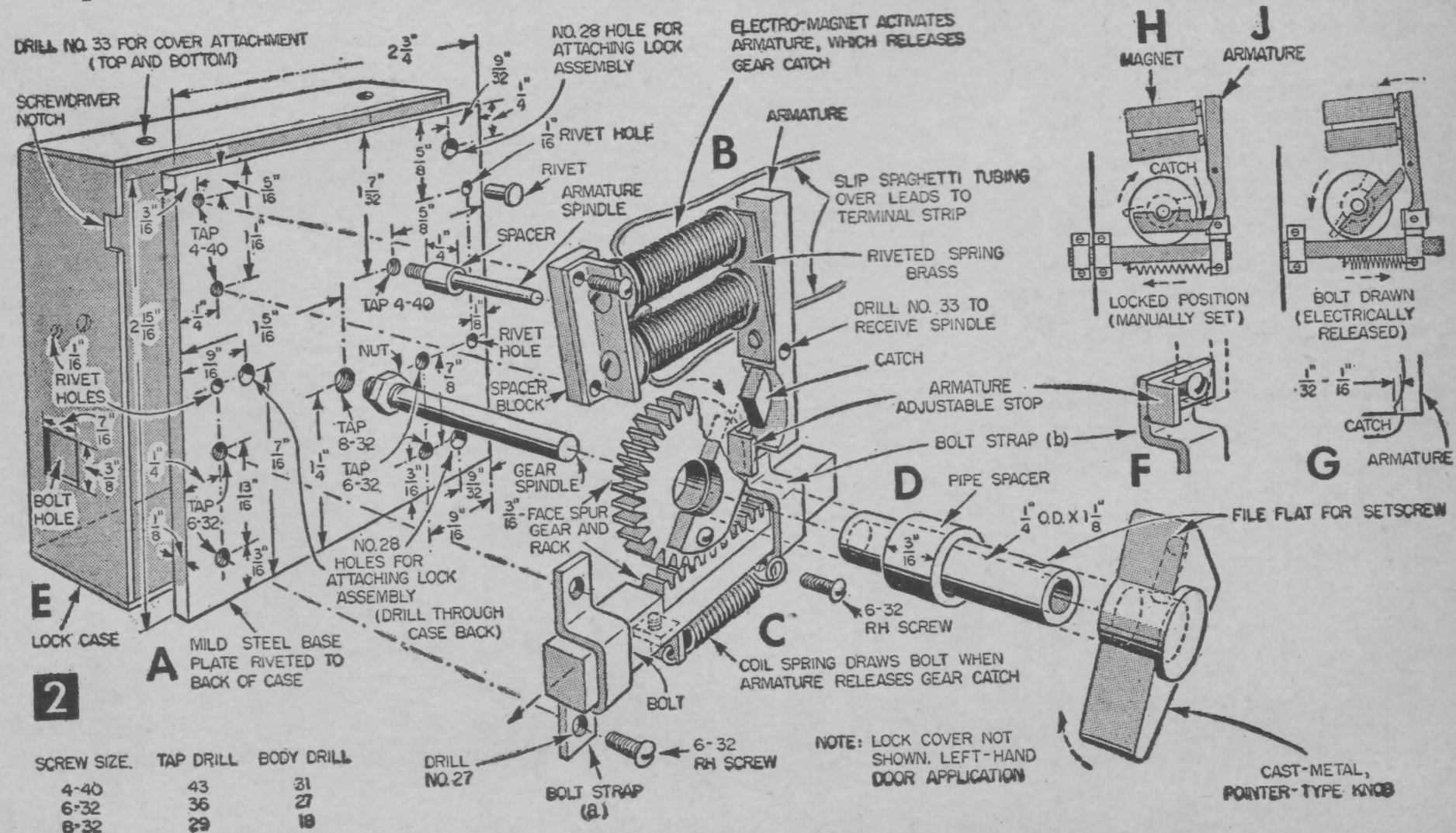
Electric DOOR LOCK





Burglar who successfully picks the regular lock would still be completely frustrated because of the auxiliary electric lock attached to inside of a door (white lines indicate its location). Wires in this instance are run down panel molding and across the door to spring contacts installed on door edge and jamb on hinge-end of door. Batteries can be located on a closet shelf or in the cellar.

THIS electric lock, mounted on your door, will frustrate any would-be burglar even if he manages to pick your regular lock. Operation of this lock is simple: The bolt is manually set by a pointer-knob, and only an electrical impulse by means of a push button, magnet and armature will release the bolt-action catch, permitting a spring to with-



SCREW SIZE.	TAP DRILL	BODY DRILL
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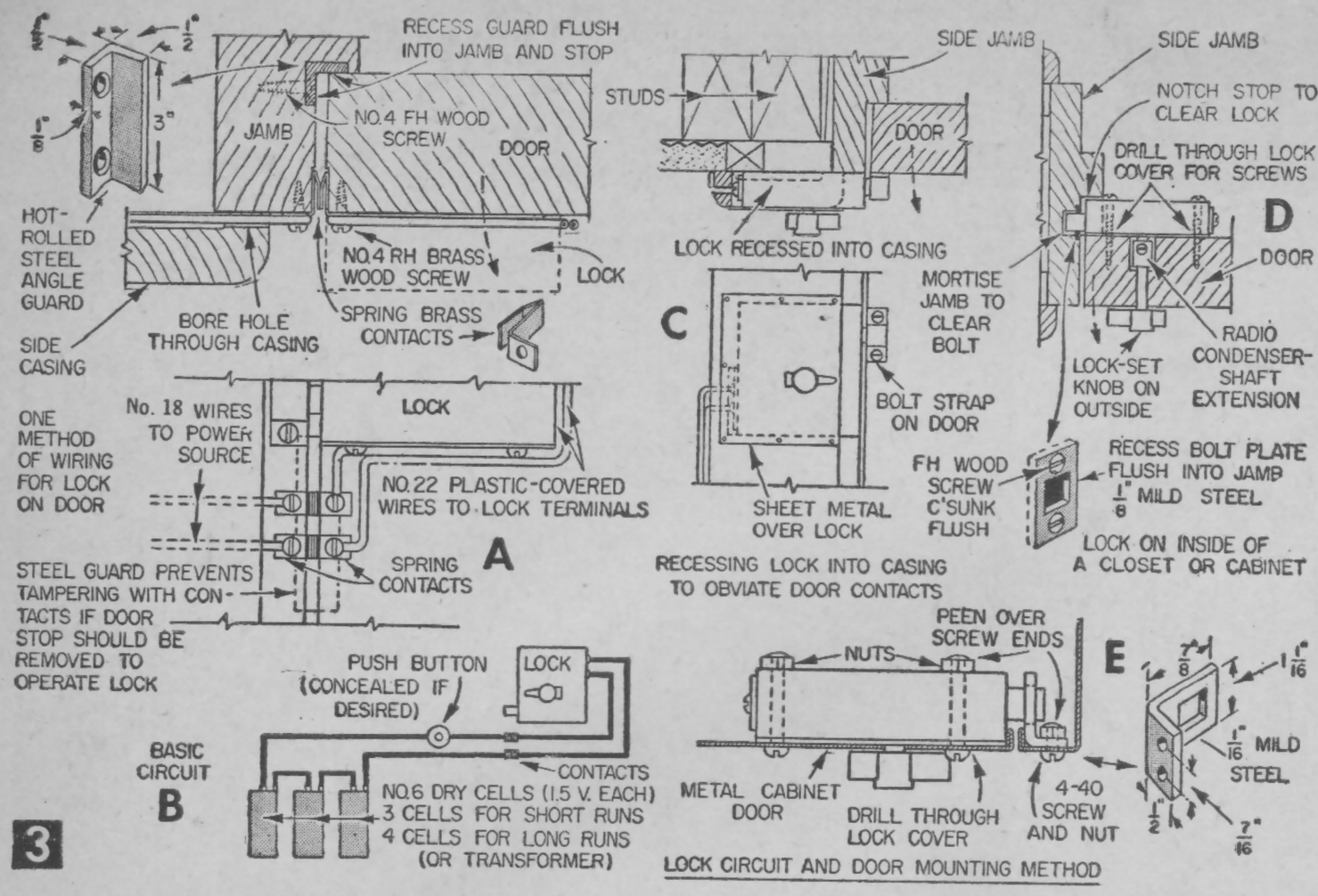
6-32	36	27
8-32	29	18



3

draw the bolt (H and J in Fig. 2). For closets, install the lock on the inside, with only the knob showing (Fig. D and E in Fig. 3.) The lock can be operated by a time switch, or numbers combination (A and B in Fig. 4) together with standard locks.

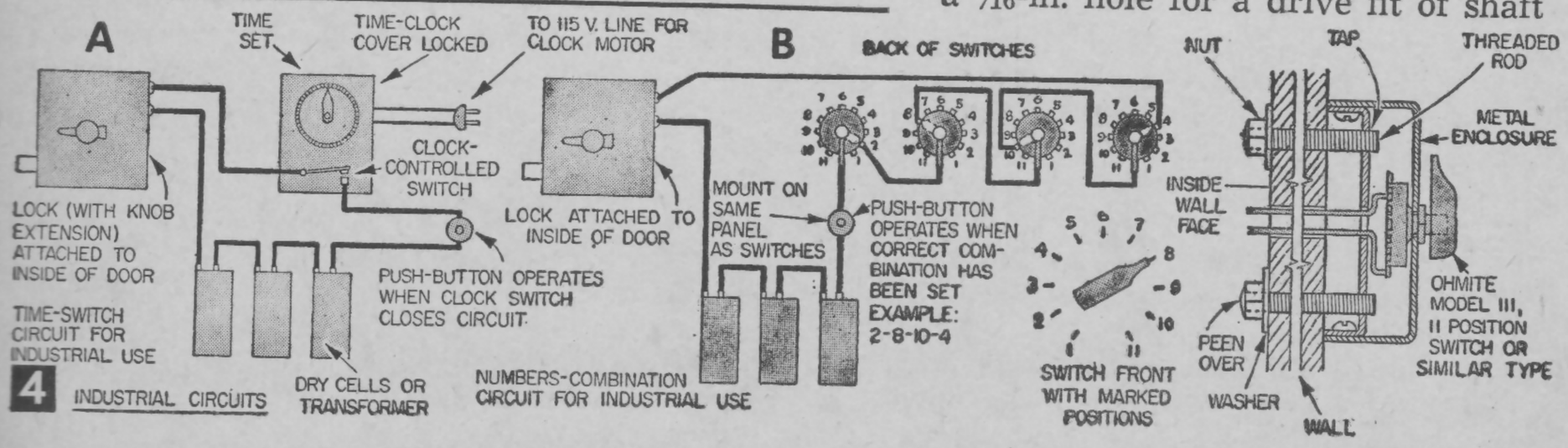
Power the lock proper with either 3 or 4 series-connected #6 dry cells totaling 4.5 to 6 volts, or a 16-volt, 10-watt chime transformer. Direct current (dry cells) will give the snappiest action.

Lock Construction. After obtaining the materials required (see Materials List), dress the cut edge of the 1/8x2¾x2 15/16 in. piece of steel for the base plate (Fig. 2A), on an abrasive disc. Lay out gear and armature-spindle, rivet and screw-attaching holes, and drill and tap spindle holes, as in Fig. 2A. Make bolt straps (J, L, and M in Fig. 5), bending carefully and filing inside corners square. Also make armature stop (Fig. 5K), drilling and filing a screw slot. Locate screw holes and drill.

Next, cut the bolt (Fig. 5G), and file or grind a rack recess. Drill and tap a screw hole for spring attachment. Then braze rack in recess. Bend a piece of strip steel, and then drill screw and spring-attachment holes (Fig. 5H and J). Next, saw and file gear catch (Fig. 5F) and locate on brass spur gear (Fig. 5C). Then clamp, and drill and tap #43 screw holes through assembly. Ream a 3/16-in. hole for a drive fit of shaft

MATERIALS LIST—ELECTRIC DOOR LOCK

1 pc	hot-rolled steel strip, 1/8 x 2¾ x 2 15/16" (base)
1 pc	h.r. steel strip, .065 x 3/8 x 4" (2 bolt straps)
1 pc	h.r. steel strip, .065 x 7/16 x 2½" (door-frame bolt strap)
1 pc	h.r. steel strip, .065 x 3/8 x ¾" (armature stop)
1 pc	h.r. steel strip, .065 x 1 x 13/16" (magnet support)
1 pc	h.r. steel strip, 1/8 x 3/8 x 1" (magnet-spacer block)
1 pc	cold-rolled steel, 3/16 x 3/8 x 1¾" (armature)
1 pc	c.r. steel strip, .083 to 3/32 x 3/8 x 1 3/16" (gear catch)
1 pc	c.r. steel, 5/16 x 3/8 x 2 13/16" (bolt)
1 pc	c.r. steel strip, .025 x ¼ x ½" (spring attachment)
1 pc	c.r. steel strip, .032 x 4½ x 4 1/16" (case)
1 pc	c.r. steel strip, .058 x 2 7/8 x 3 9/16" (cover)
1 pc	c.r. steel rod, ¼" dia. x 1⅛" (gear shaft)
1 pc	drill rod, .157" dia. x1¼" (gear-shaft spindle)
1 pc	drill rod, .111" dia. x7/8" (armature spindle)
2 pcs	soft-iron rod, ¼" dia. x 1½" (magnet cores)
1 pc	flat spring brass, .008 x 5/16 x 1¼" (armature spring)
1	brass spur gear, 3/16" face; 14½° pressure angle; 15/16" pitch dia.; 32 pitch; 30 teeth (Boston Gear Works, Cat. G-174)
1 pc	steel rack, 3/16" face; 14½° pressure angle; 32 pitch x 1 1/16" approx. (Boston Gear Works Cat. L503)
1	steel coil spring, .035 x 5/16 o.d. x 9/16" plus ends (bolt spring)
4	magnet spool ends, 1/32 x ½" dia. Bakelite
3 oz	#22 Formvar, Formex or enameled magnet wire
1	Jones #17-2 terminal strip
1	die-cast pointer-type knob, National Type HRB
1 pc	5/16" dia. steel rod, ¼" long (armature-spindle spacer) washer or washers as need (armature-spindle spacer)
1 pc	⅛"-pipe x 3/16" (gear-shaft spacer)
1	8-32 nut (gear-shaft spacer-lock)
1	6-32 x ¼" rh machine screw (armature stop)
2	6-32 x 7/16" rh machine screws and lock washers (magnet cores)
2	4-40 x 9/32" rh machine screws (gear catch)
1	4-40 x 5/32" rh machine screw (bolt-spring attachment)
2	4-40 x 5/16" rh machine screws (magnet-spacer-block attachment)
4	4-40 x 3/32" rh machine screws (cover attachment)
2	4-40 x ¼" rh machine screws and nuts (terminal-strip attachment)
3	#6 rh wood screws of adequate length (lock attachment)
2	brass or aluminum rivets, 1/16 x 5/32" approx. (base attachment)
1	brass or aluminum rivet, 1/16 x ¼" approx. (armature spring)



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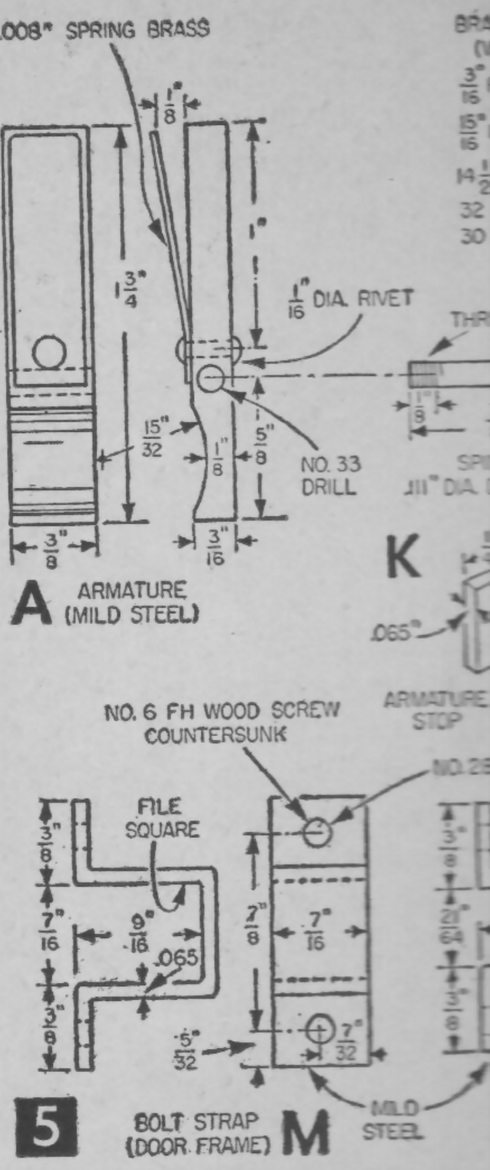

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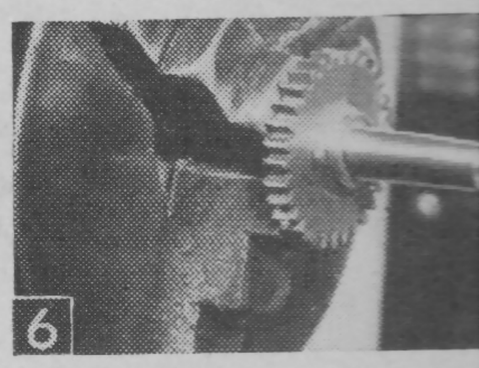

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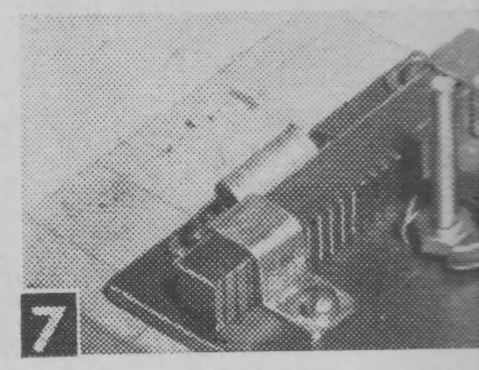

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draw the bolt (H and J in Fig. 2). For closets, install the lock on the inside, with only the knob showing (Fig. D and E in Fig. 3.) The lock can be operated by a time switch, or numbers combination (A and B in Fig. 4) together with standard locks.

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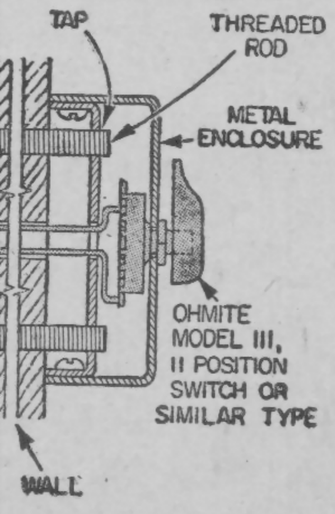
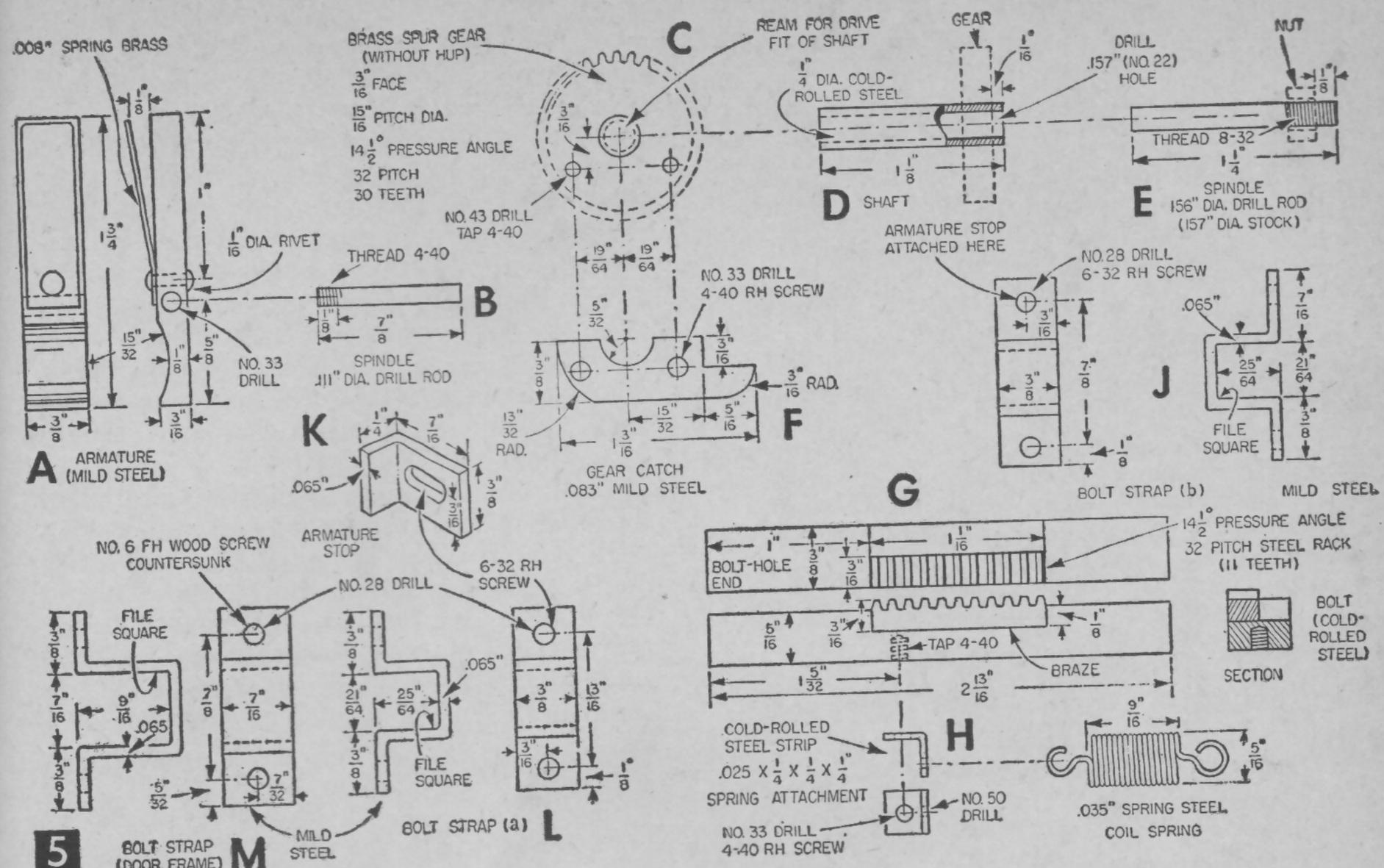
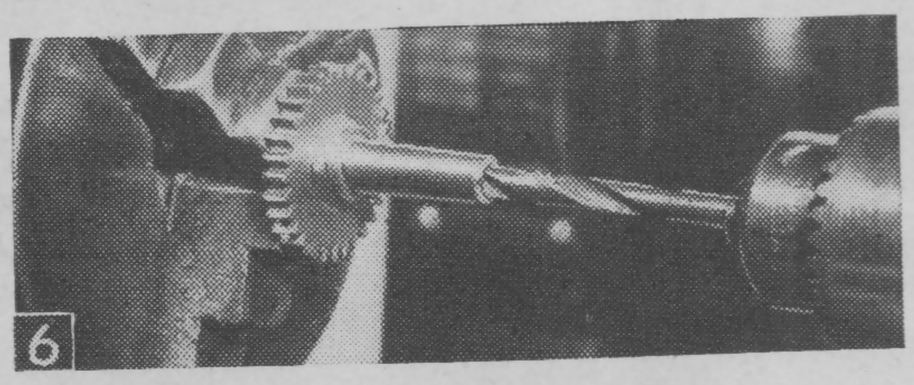
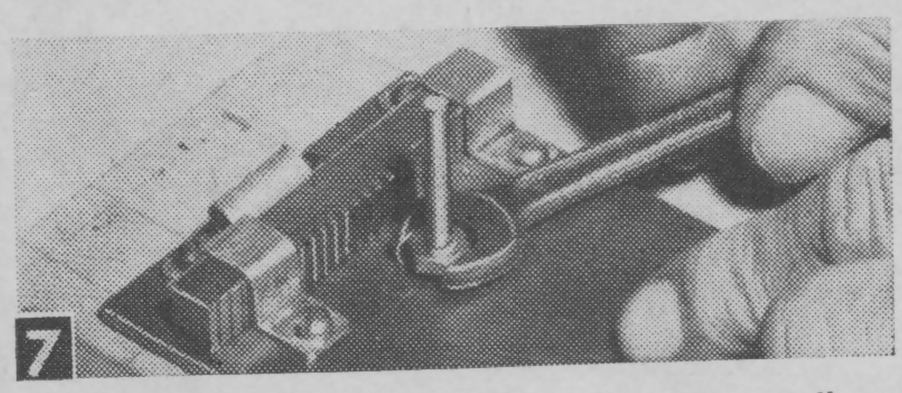






Using a lathe to drill shaft hole for spindle. Use a shaft longer than specified for checking and cut to project 1/16 in. beyond gear on chuck-end after drilling.



With nut tightly screwed on, screw in gear spindle with a wrench, to lock spindle in place.

(Fig. 5C and D). Then, drill or ream #33 catch screw holes for 4-40 *rh* screws.

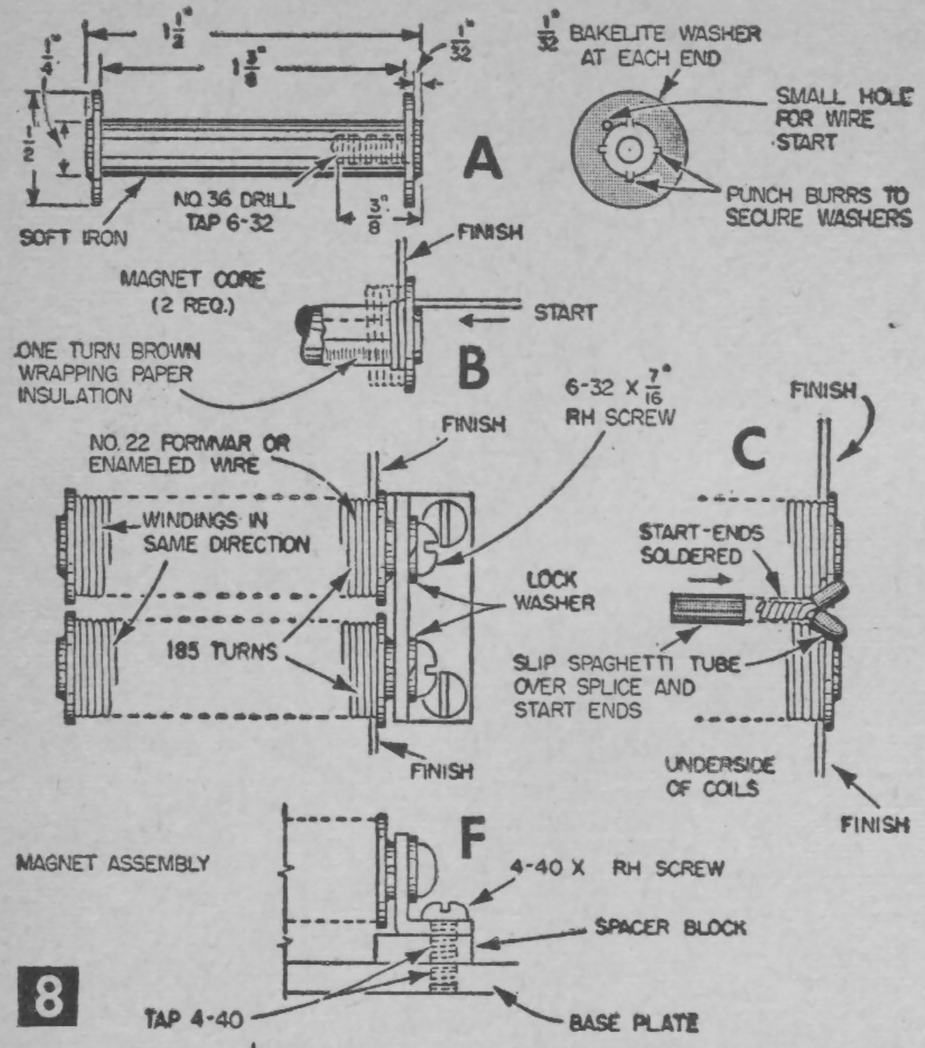
Assemble gear and shaft and, in the lathe, drill shaft to receive spindle (Figs. 5D, E and 6). Chuck spindle in lathe and dress diameter to a slide fit into shaft. Thread spindle 8-32 and screw on a nut tightly. Now, screw spindle into baseplate (Figs. 2A and 7).

Make the armature (Fig. 5A) drilling a #33 hole to receive spindle (Fig. 5B). Drill hole for rivet and attach spring brass. Thread spindle 4-40 for baseplate.

Now, assemble bolt and gear on baseplate and locate strap holes, making sure that gear and rack teeth mesh without binding or excessive lost motion. Bolt must slide freely through straps, or spring may not function. Drill and tap screw holes in baseplate and assemble gear, bolt, straps, spring and armature stop. Also screw in armature spindle and assemble armature using washers as required (Fig. 2A).

For the magnet cores (Fig. 8A), use pieces cut from wrought-iron bolts (soft iron). Drill a #36 hole in one end of each core in the lathe, and tap 6-32 for attaching screws. Make spool ends from Bakelite, drilling slightly undersize ¼-in. core holes and a small hole in one washer each, for wire start. Attach spool ends and, with a punch, burr ends of cores to keep Bakelite on. Wind the wire on the lathe (Fig. 9), or use a hand drill clamped in a vise by means of a screw tight in the core, protruding about ½-in. with its head cut off. Over a layer of brown wrapping paper around each core (Fig. 8B), wind 185 turns of #22 Formvar, Formex or enameled magnet wire in smooth, even layers. To do this, slip start-end of wire through hole in spool-end and tape to chuck. After winding, secure finish ends with carpet thread (Fig. 10), and coat entire coil with full-strength orange shellac.

Make a bracket and spacer block (Fig. 8D and E) to support coils as shown in Fig. 8F, with start-ends spliced under coils, soldering the splice and pressing a piece of small diameter spaghetti tubing over the splice to insulate it (Fig. 8C). Coils should be wound



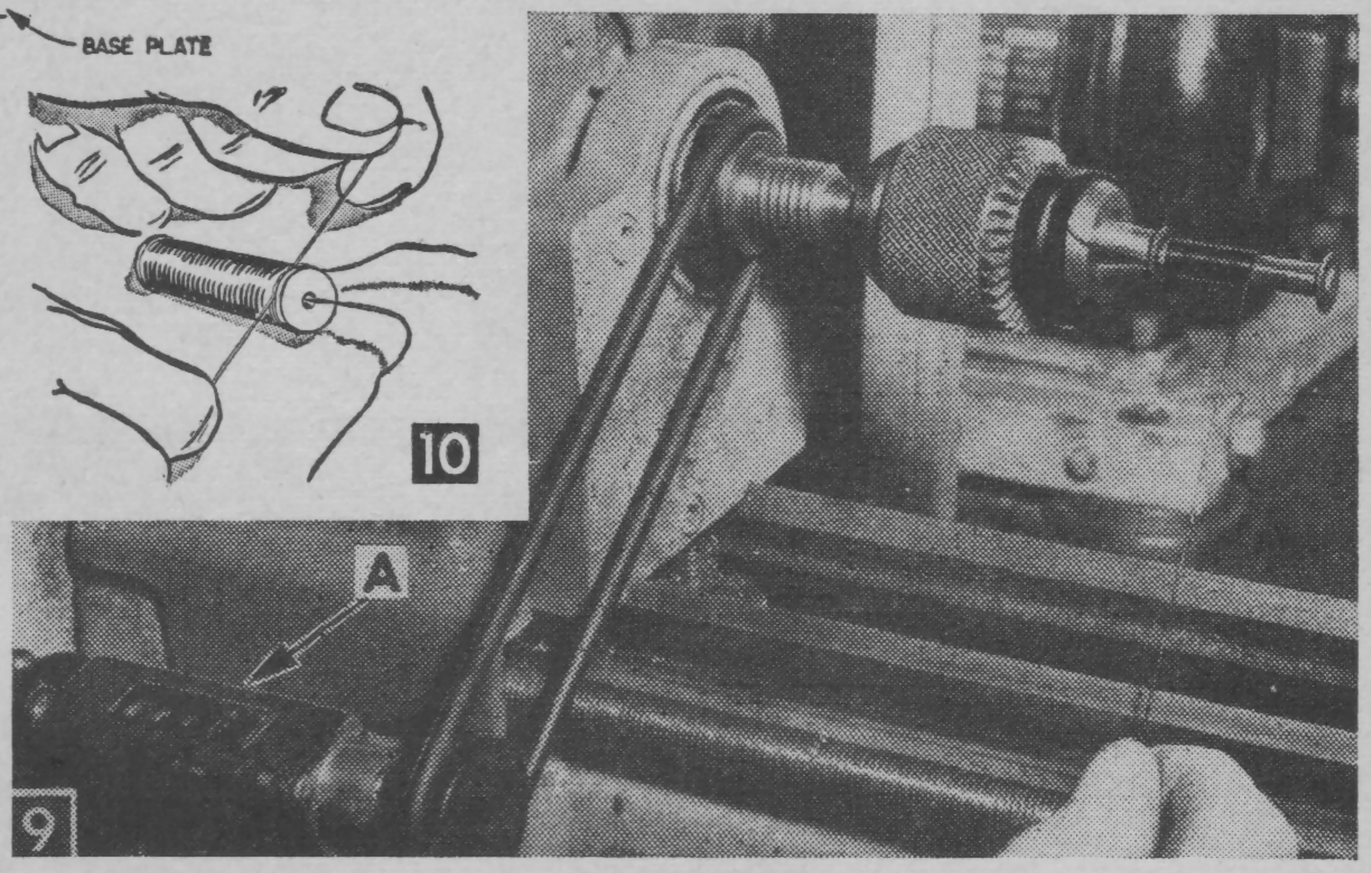
in the same direction and the start ends connected to produce a north and south pole at the free ends of the cores. Check with a battery and magnetic compass. Locate magnet assembly on baseplate so armature spring touches each magnet core with a very slight tension and the armature end is against stop, with gear catch lapping on end of armature 1/32 in. (Figs. 2F, G, H, and Figs. 11, 12 and 13).

If there is too great a lap of the catch on the end of the armature, the bolt spring may cause enough friction at this point to prevent magnet from attracting armature and releasing catch. The armature spring-brass strip serves two purposes: to hold armature in position on gear catch when not energized, and as a non-magnetic material between magnet poles and armature, to prevent sticking due to residual magnetism. After locating magnet assembly, drill and tap screw holes in baseplate. Determine the right amount of gear-catch lap on armature by testing with 3 or 4 dry cells and adjusting stop.

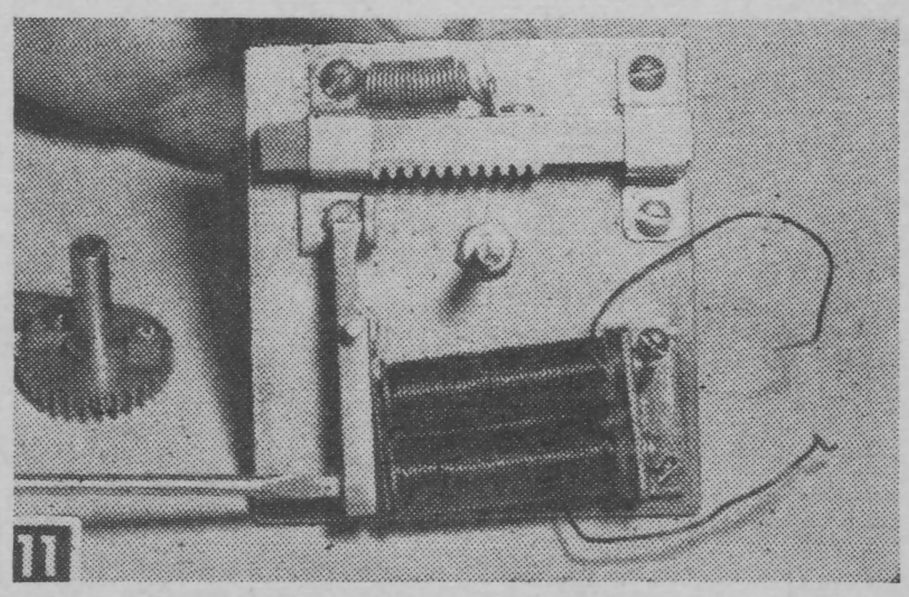
Making Case and Cover. Figure 14 shows how to form the case and cover for a snug fit. Test assemble them to locate attaching screws. Then clamp and drill through assembly, and tap cover holes 4-40, and drill case holes #33. Now, locate baseplate in the case and, from the base, locate rivet and attaching-screw holes. Also locate, drill and file to shape the bolt hole in the case which must clear the bolt freely (Fig. 2E).

Disassemble lock mechanism and rivet the base to the case with rivets flush with back face of case. Install a terminal strip, drilling holes as shown in Fig. 14D, making terminals clear the case to prevent shorting. Attach magnet assembly to base, slip spaghetti tubing over finish wires, bringing them under coils. Solder cleaned ends to terminals (Fig. 15). Make sure wires clear armature movement.

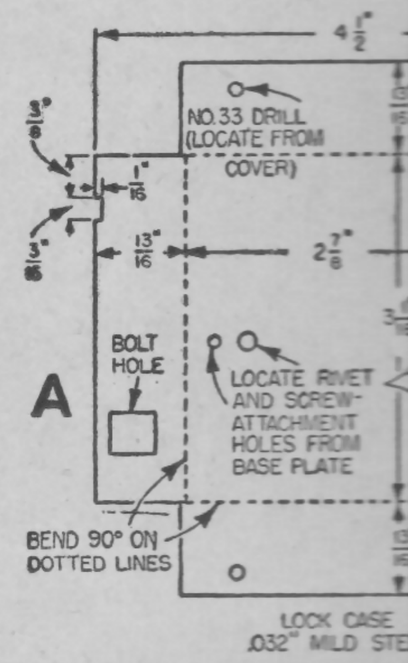
Next, reassemble lock mechanism, oiling moving parts, and using a pipe spacer on shaft between cover and gear to take up excessive end play; add washers between armature and cover, each with a clearance of about 1/64 in. when cover is attached (Figs. 2C and 14C). Locate pointer-knob on shaft (Fig. 2D) so



Winding magnet coils is easiest done in your lathe, at 50-100 rpm speeds, by passing "start"-end wire through hole in spool-end and taping to chuck. In this lathe rig, a temporary turn counter (A) is rigged up with a rubber vacuum cleaner belt and 1:1 ratio pulleys. Tie "finish"-ends of wire with carpet thread to keep them secure, then shellac coil to help keep turns in place.



With magnet and armature in place, you can test spring action of armature for enough tension to return armature to stop.



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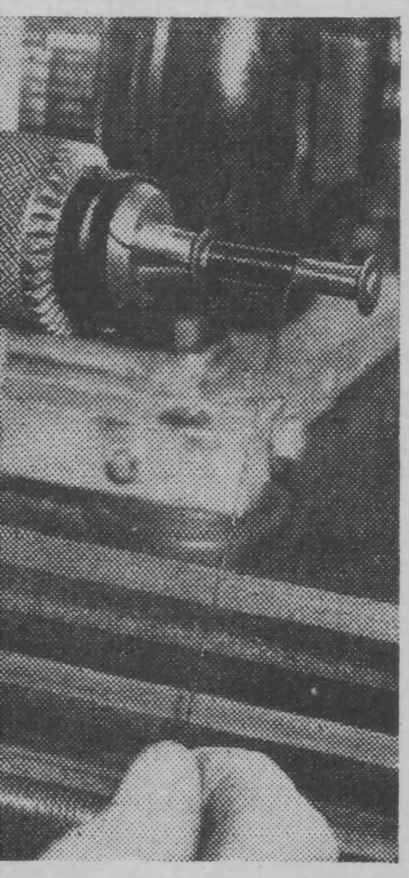
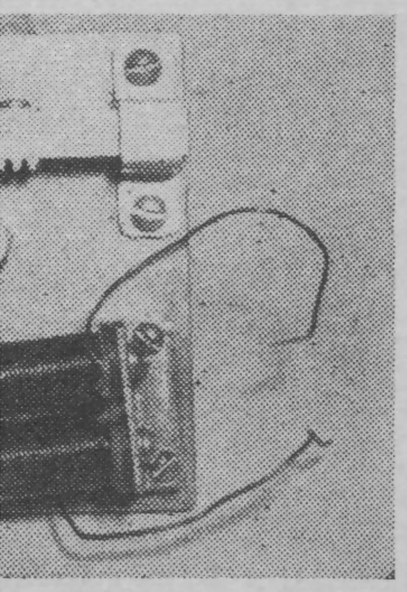


50-100 rpm speeds, by taping to chuck. In this with a rubber vacuum wire with carpet thread turns in place.



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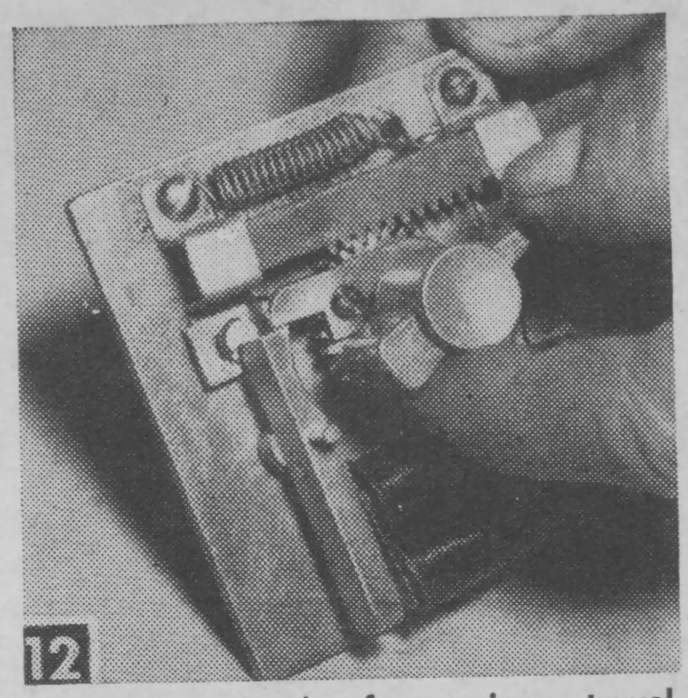

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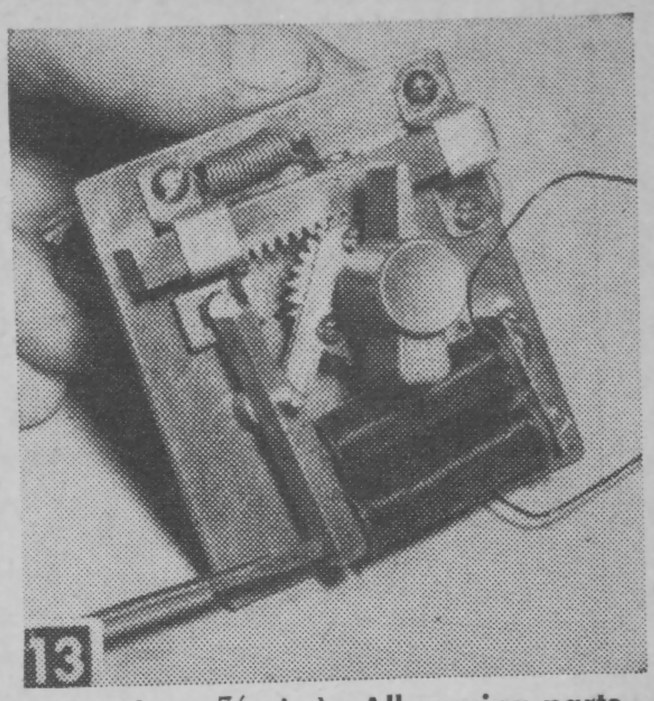
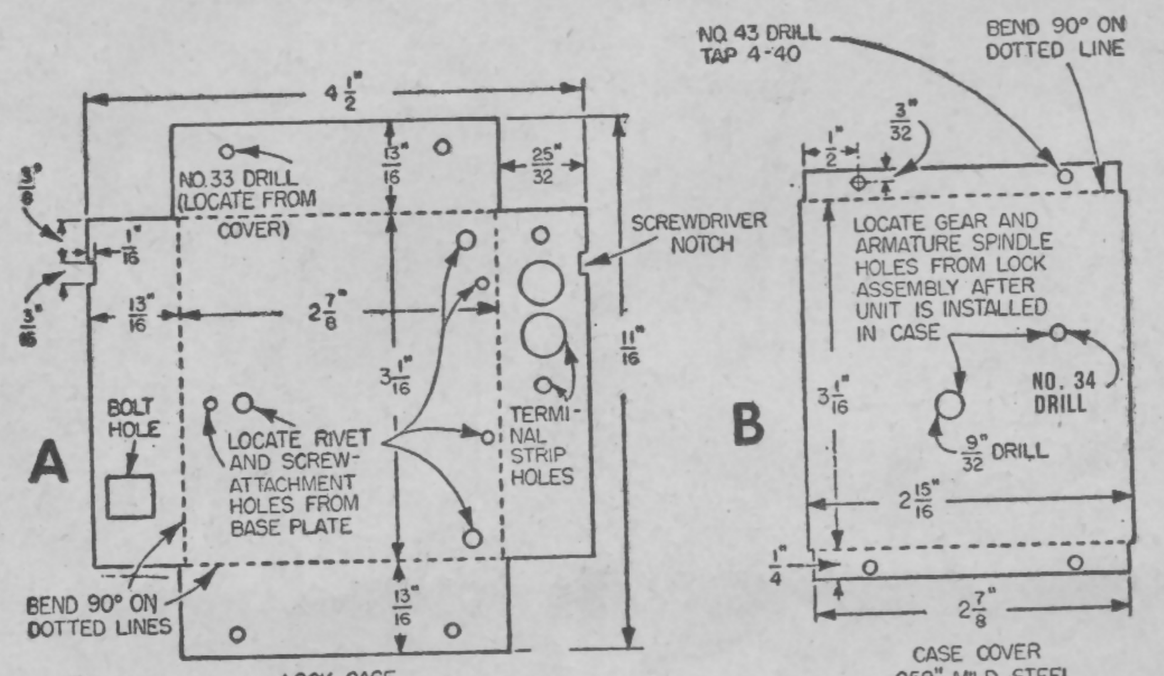
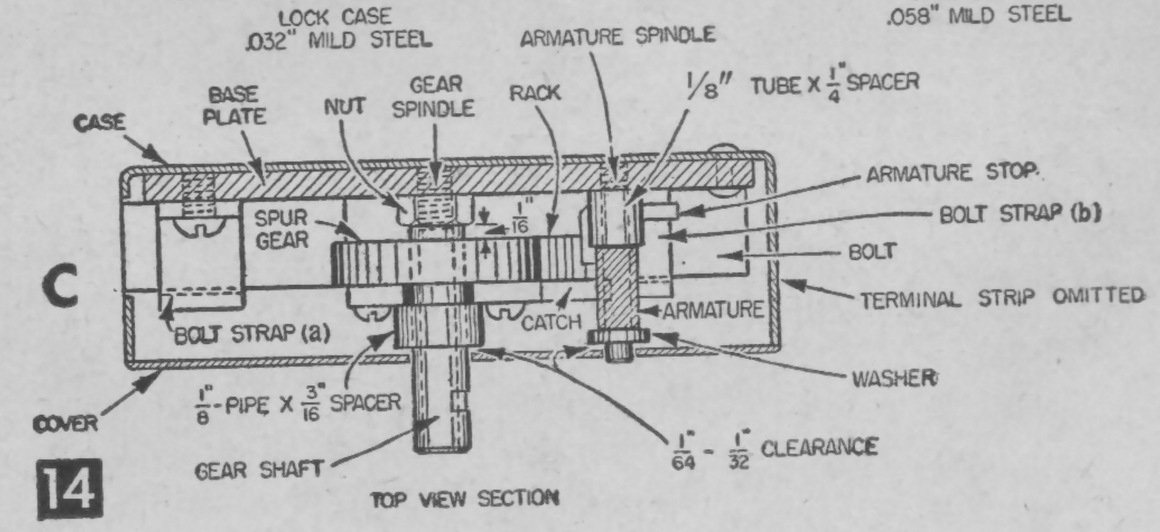


13

Testing gear action for maximum travel of bolt (about 7/16 in.). All moving parts must work freely without friction. Set bolt in "lock" position and press on armature to test overlap of gear catch and armature end, and catch-arc clearance.





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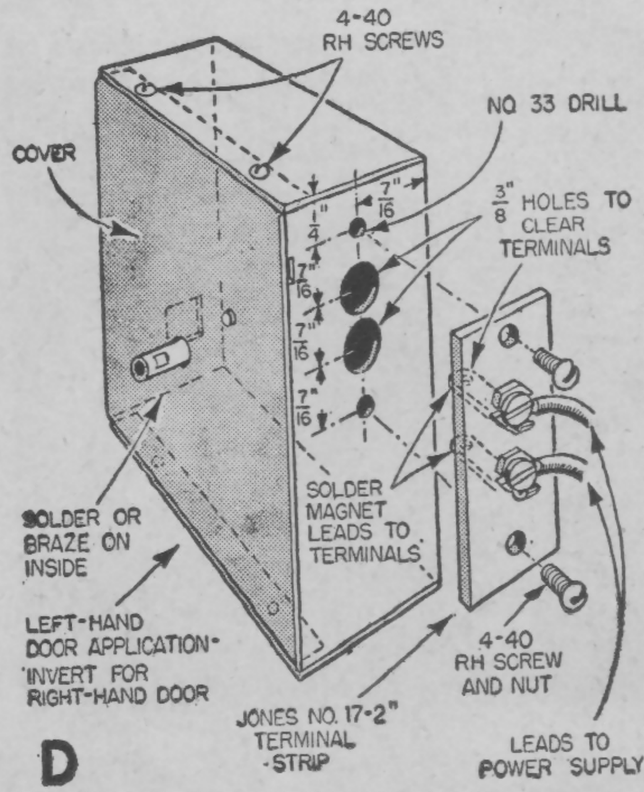
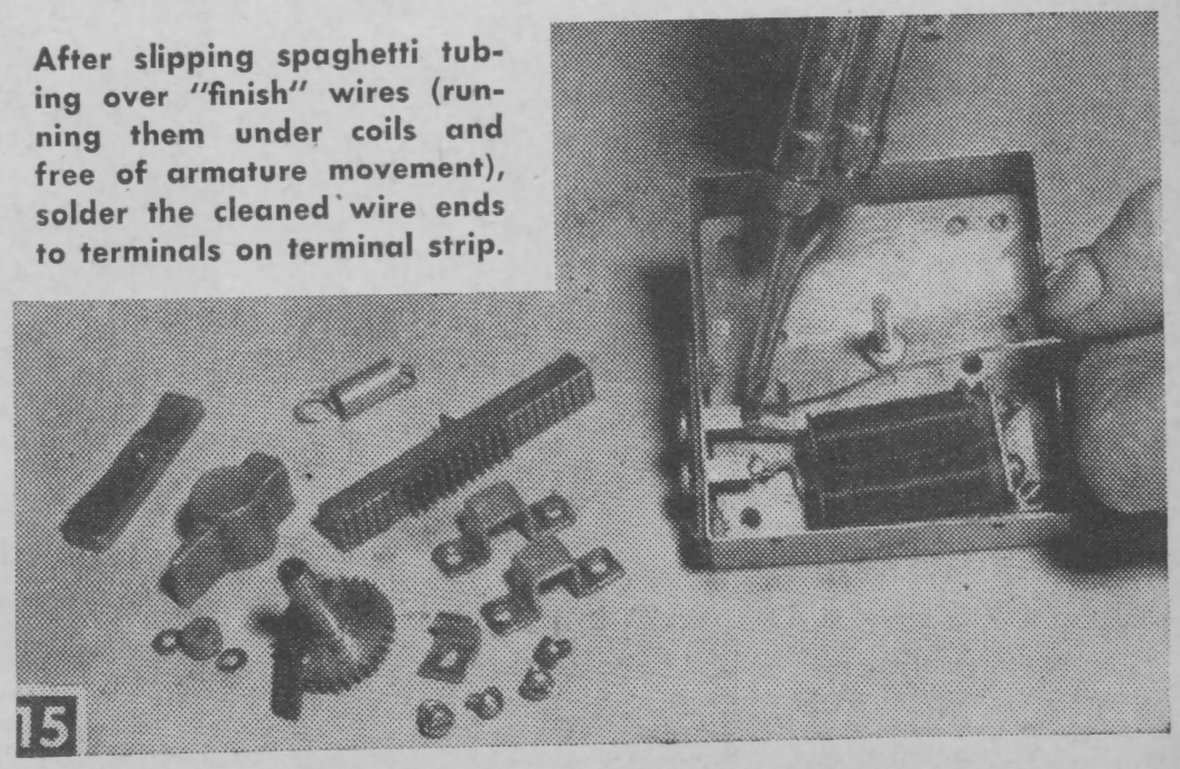


pointer is parallel to bolt in locked position.

You can polish the entire lock case with fine abrasive cloth and give it a coat or two or clear lacquer or paint it. For attachment to wood surfaces (Fig. 3C and D), use #6 *rh* wood screws of adequate length, either from inside or outside of lock, as needed.

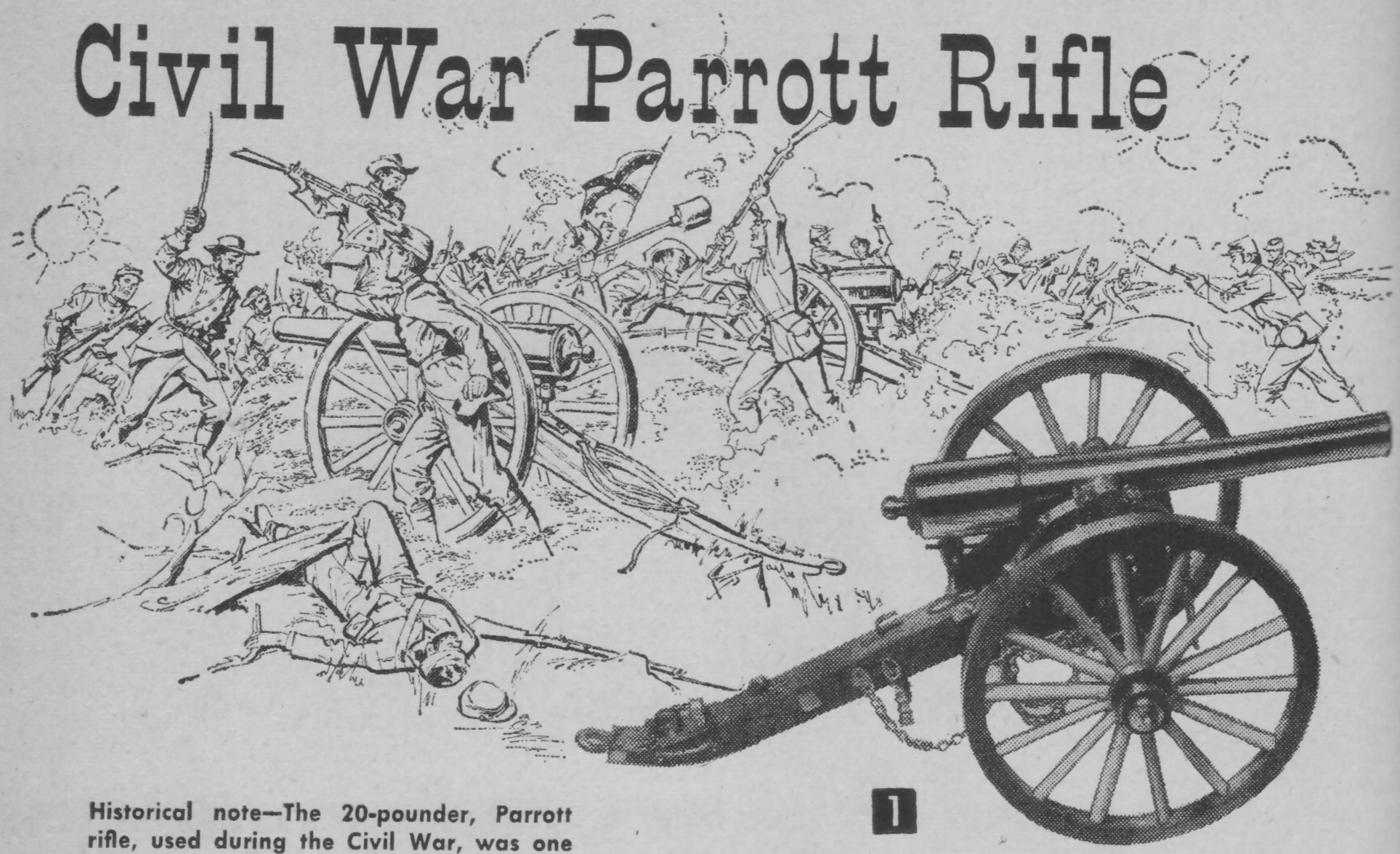
Install the lock so the bolt fits freely in the strap (Fig. 5M). If the bolt binds in the strap, the coil spring that returns the bolt may not be able to draw the bolt back when the magnet has released the mechanism. On the other hand, if this spring tension is increased too much, the magnet may lack sufficient power to pull the armature over to effect the release. Shim the latter or fit in the door frame as needed.—HAROLD P. STRAND.

After slipping spaghetti tubing over "finish" wires (running them under coils and free of armature movement), solder the cleaned wire ends to terminals on terminal strip.



15

Centennial Model of the Civil War Parrott Rifle



1

Historical note—The 20-pounder, Parrott rifle, used during the Civil War, was one of the first rifled guns used in the United States. Because its accuracy and range was far greater than the older cannons firing cannon balls, the Parrott rifle figured decisively in the battle of Gettysburg and the siege of Fort Pulaski.

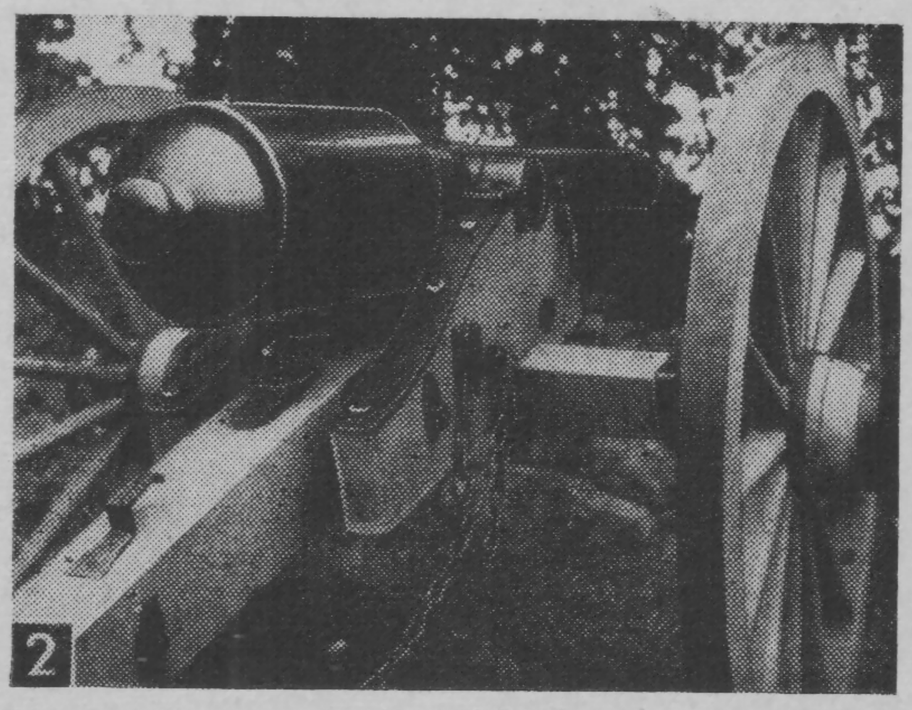
A master modelmaker shows you how to make an authentic copy of this famous Civil War Cannon scaled ¾ inch to the foot from the original

By ROBERT H. DALTON

SINCE the value and interest in this accurately scaled cannon model is certain to increase as we approach the Civil War Centennial, (1961-1965) we are publishing the plans now to give you plenty of time to make a duplicate for yourself, as a gift or for sale.

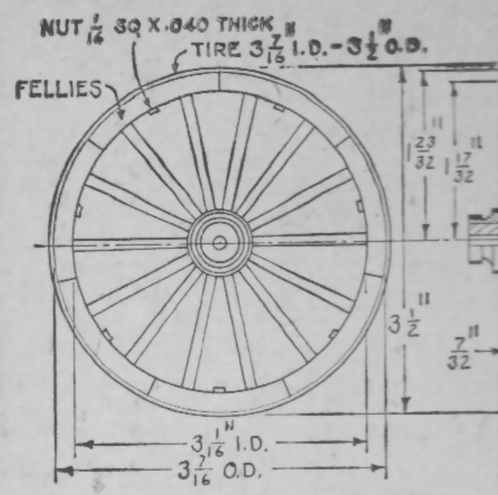
Measurements for the model (Fig. 1) were taken directly from one of the original guns (Fig. 2), now at Gettysburg. Although the barrels of the old cannons were made of cast iron with wrought iron used for the other metal parts, we modeled the metal parts of brass and used walnut for all wooden parts except the wheel spokes, which are of maple. This combination gives the model a sparkling jewel-like appearance that will attract attention on a desk or fireplace mantel of your home.

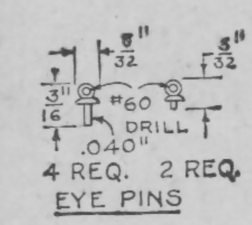
The small amounts of brass rod and sheet metal required to build the model may be purchased from Charles A. Cole, 1355 Church Street, Ventura, California. Model makers pins, escutcheon pins used for brads and brass chains may be purchased from Marine Model Co., Halesite, Long Island, New York.

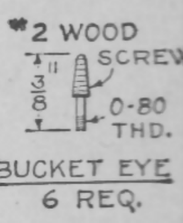


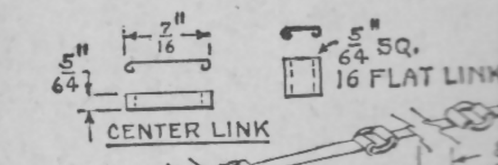
2

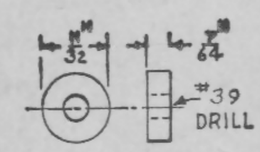
One of the original Parrott guns used during the Civil War. Photo taken at Gettysburg, Pennsylvania.

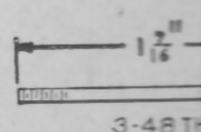


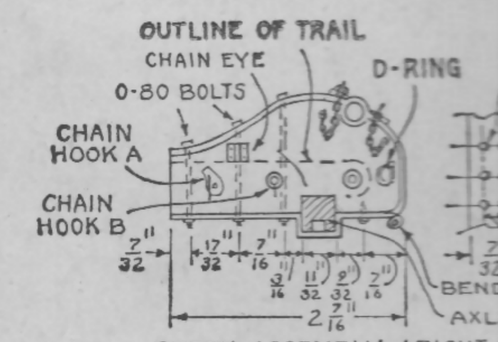


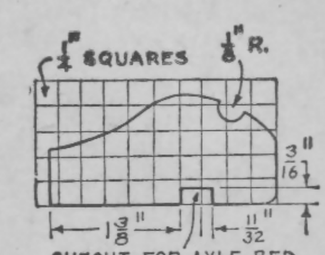


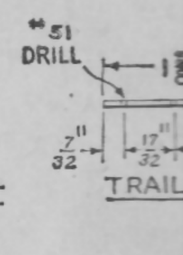


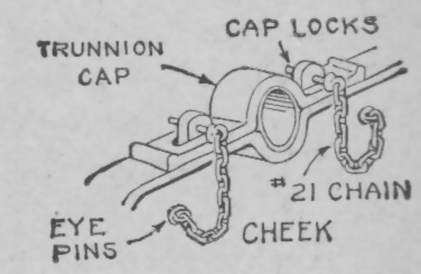


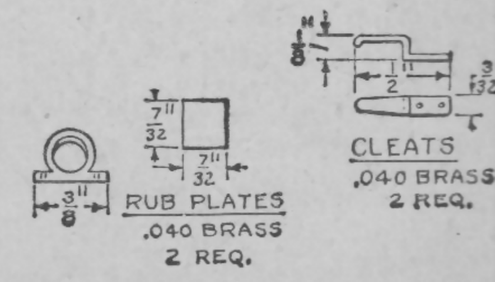












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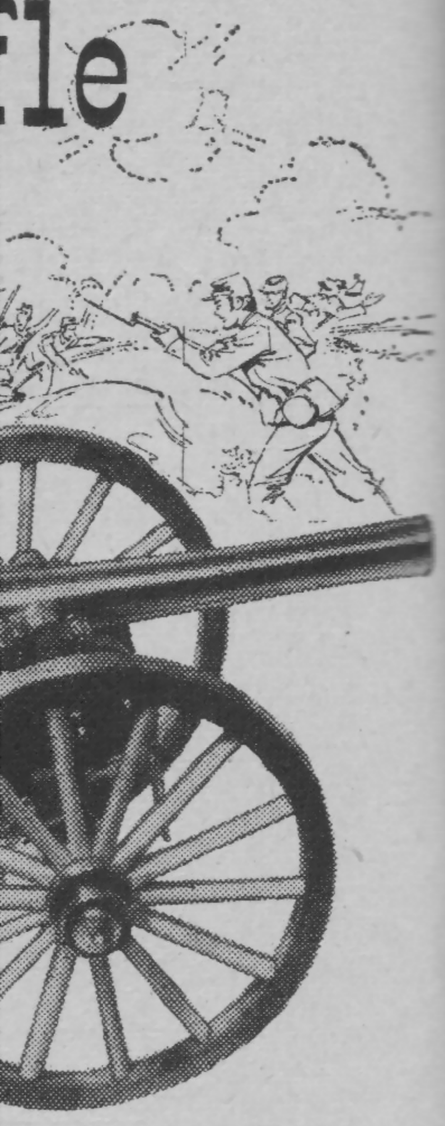

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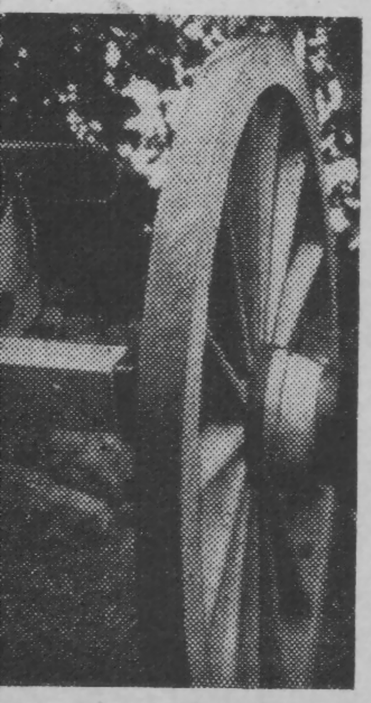

uns used during the
rsburg, Pennsylvania.

NCE AND MECHANICS

NUT $\frac{1}{16}$ SQ X .040 THICK
TIRE $3\frac{7}{16}$ I.D. - $3\frac{1}{2}$ O.D.
FELLIES
ALL BANDS $\frac{1}{32}$ X $\frac{3}{32}$
$\frac{5}{8}$" O.D.
$\frac{9}{16}$" O.D.
HUBS
$\frac{3}{8}$"
$\frac{1}{8}$" HOLE
$\frac{23}{32}$"
$\frac{17}{32}$"
$\frac{1}{2}$"
$\frac{9}{16}$"
$\frac{11}{32}$"
$\frac{17}{32}$"
$\frac{11}{32}$"
$\frac{7}{8}$"
$3\frac{1}{2}$"
$\frac{7}{32}$"
$3\frac{1}{16}$" I.D.
$3\frac{7}{16}$" O.D.

WHEELS 2 REQ.

HUB AND WHEEL ASSEMBLY

$\frac{5}{32}$" ROUND TENON
$\frac{1}{16}$"
$\frac{3}{16}$"
$\frac{1}{8}$"
FILE OVAL SHAPE
$1\frac{13}{32}$"
$\frac{1}{8}$" HOLE
SQUARE
$\frac{1}{8}$"

SPOKES
28 REQ.

$\frac{15}{64}$"
$\frac{15}{64}$"
TUBE
.093 O.D.
.065 I.D.

CHAIN EYE
2 REQ.

$\frac{5}{16}$" PILOT
5 SLOTS $\frac{11}{16}$" WIDE .025" DEEP
$\frac{1}{4}$"
$3\frac{1}{4}$"
.210" DIA.
.187"
.195"
.200"
.205"
.210"
$1\frac{1}{4}$"
.025"
1 2 3 4

4 STAGES IN MAKING BROACH FOR SIMULATING LANDS AND GROOVES IN BARREL. 1 REQ. DRILL ROD

$\frac{11}{16}$"
.040" .075 X .140" SLOT
$\frac{7}{32}$"

TRUNNION CAP
2 REQ.

$\frac{5}{32}$"
$\frac{5}{32}$"
$\frac{3}{16}$"
#60 DRILL
.040"

4 REQ. 2 REQ.
EYE PINS

#2 WOOD SCREW
$\frac{3}{8}$"
0-80 THD.

BUCKET EYE
6 REQ.

#39 DRILL
$\frac{7}{16}$"
$\frac{1}{4}$"

CHAIN HOOK A
.030 BRASS 2 REQ.

$\frac{1}{4}$"
#39 DRILL
SOLDER
$\frac{3}{16}$"
.030" WIRE

CHAIN HOOK B
1 REQ.

$\frac{1}{4}$"
$\frac{1}{4}$"
$\frac{5}{8}$"
$\frac{3}{16}$" DIA.
SOLDER
$\frac{3}{16}$" DIA.

RAMMER HOOKS .050" BRASS WIRE 1 EACH REQ.

$\frac{5}{16}$"
.050" BRASS WIRE
$\frac{5}{16}$"
$\frac{13}{16}$"

D-RING
2 REQ.

$\frac{7}{16}$"
$\frac{5}{64}$"
CENTER LINK
$\frac{5}{64}$" SQ.
16 FLAT LINKS
8 LINKS
CENTER LINK
8 LINKS

#10 OVAL LINKS FLATTENED, 18 REQ.

$2\frac{13}{16}$"
$\frac{11}{32}$"
$\frac{15}{16}$"
$\frac{15}{16}$"
$\frac{15}{16}$"
$\frac{11}{32}$"
$\frac{3}{8}$"

AXLE BED
1 REQ.

$\frac{1}{32}$" BRASS
$\frac{5}{64}$"
$\frac{11}{32}$" SQ.
SOLDER
.015" HOLE ONE SIDE

BED BANDS
2 REQ.

$\frac{1}{8}$" DIA.
$\frac{11}{32}$"

LINCH PINS
.040" COPPER WIRE
2 REQ.

$\frac{11}{32}$"
$\frac{7}{64}$"
#39 DRILL

CHEEK SPACER
6 REQ.

$1\frac{7}{16}$"
3-48 THD.

CHEEK STUDS
$\frac{3}{32}$" BRASS ROD 3 REQ.

$5\frac{1}{4}$"
$\frac{5}{32}$"
$2\frac{5}{8}$"
#51 DRILL
$2\frac{13}{16}$" SQ. SECTION
#57 DRILL

AXLE - 1 REQ.

.075"
$\frac{1}{8}$" DRILL
$\frac{11}{32}$"
2° CHAMFER

AXLE WASHERS
4 REQ.

OUTLINE OF TRAIL
CHAIN EYE
0-80 BOLTS
D-RING
BRADS
CHAIN HOOK A
CHAIN HOOK B
$\frac{5}{32}$"
$\frac{5}{16}$"
$\frac{1}{8}$"
$\frac{7}{32}$"
$\frac{7}{32}$"
$\frac{17}{32}$"
$\frac{7}{16}$"
$\frac{3}{16}$"
$\frac{11}{32}$"
$\frac{2}{32}$"
$\frac{7}{16}$"
$2\frac{7}{16}$"
BEND FOR RAMMER
AXLE BED

CHEEK ASSEMBLY 1-RIGHT 1-LEFT

#60 DRILL
$\frac{3}{16}$"
6-48 TAP
$\frac{5}{8}$"
$\frac{5}{8}$"
25°
$\frac{2}{32}$"
$\frac{1}{4}$"

ELEVATING SCREW AND BASE 1 REQ.

$1\frac{1}{2}$" R.
TRAIL 1 REQ. WALNUT
#40 DRILL 3 HOLES
$\frac{21}{32}$"
$\frac{25}{32}$"
$\frac{3}{16}$" R.
$\frac{3}{16}$"
$\frac{7}{16}$"
$\frac{9}{16}$"
$\frac{1}{8}$"
$\frac{5}{16}$"
$1\frac{1}{16}$"
$\frac{1}{32}$"
$\frac{3}{16}$"
$\frac{23}{32}$"
$5\frac{7}{8}$"
$\frac{1}{8}$" BRASS RING
#57 DRILL
$\frac{1}{16}$" DRILL
$\frac{13}{32}$"
$\frac{1}{4}$"
$\frac{3}{16}$"
$\frac{7}{16}$"
$\frac{5}{16}$"
$\frac{5}{32}$"
$\frac{3}{32}$"
$\frac{5}{32}$"
$\frac{7}{64}$"
$\frac{1}{32}$"
$\frac{5}{32}$"
$\frac{1}{16}$"
$\frac{3}{8}$"
$\frac{1}{8}$"
15°

LUNETTE
$\frac{1}{32}$" BRASS 1 REQ.

HANDSPIKE RINGS
1 REQ. EACH

$\frac{1}{4}$" SQUARES
$\frac{1}{8}$" R.
$\frac{3}{16}$"
$1\frac{3}{8}$"
$\frac{11}{32}$"
CUTOUT FOR AXLE BED

CHEEK
$\frac{7}{32}$" WALNUT 2 REQ.

#51 DRILL
$1\frac{3}{8}$"
$\frac{7}{16}$"
$\frac{7}{32}$"
$\frac{17}{32}$"
$\frac{17}{32}$"
$\frac{23}{32}$"
$\frac{1}{4}$"
$\frac{3}{8}$"

TRAIL STRAP .040 X $\frac{7}{32}$" BRASS 1 REQ.

$\frac{3}{64}$"
$\frac{3}{16}$"
$\frac{1}{4}$"

HANDLES 4 REQ.

HANDSPIKE RINGS
ELEVATING SCREW BASE
$\frac{7}{16}$"
$1\frac{13}{16}$"
$\frac{11}{16}$"
$1\frac{11}{16}$"
CLEATS
LUNETTE
LIFTING GRIPS
RUB PLATE
$\frac{19}{32}$"
$\frac{7}{16}$"
$\frac{7}{32}$"
CHAIN RING
STUD NUT

TRAIL ASSEMBLY

$\frac{5}{8}$"
$\frac{3}{16}$"
$\frac{3}{16}$"
FLATTEN
.015 DRILL

LIFTING GRIPS
.050 BRASS WIRE 2 REQ.

$\frac{5}{64}$"
0-80 TAP
$\frac{5}{16}$"
$\frac{5}{32}$"

STUD NUTS
.040 BRASS
1 REQ.

CAP LOCKS
TRUNNION CAP
#21 CHAIN
EYE PINS
CHEEK

$\frac{3}{4}$"

STUD WING NUT
0-80 THD. 1 REQ. 0-80 THD. 2 REQ.

TRUNNION
$\frac{11}{16}$" D.
$\frac{3}{4}$" D.
$\frac{19}{32}$" D.
$\frac{1}{32}$" D.
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$\frac{3}{8}$" D.
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$\frac{11}{32}$"
.030" VENT
$1\frac{1}{8}$"
$\frac{25}{32}$"
$\frac{3}{16}$" BORE
5 LANDS
5 GROOVES
$1\frac{1}{2}$"
$2\frac{15}{16}$"
$1\frac{1}{16}$"
$\frac{3}{8}$"
$\frac{1}{2}$"
$5\frac{7}{32}$"

BARREL $\frac{3}{4}$" BRASS ROD 1 REQ.

$\frac{5}{64}$"
.065 X $\frac{11}{64}$" SLOT
$\frac{3}{8}$"

STRAP HANGER
.040 BRASS
2 REQ.

$\frac{7}{32}$"
$\frac{7}{32}$"
$\frac{3}{8}$"

RUB PLATES
.040 BRASS
2 REQ.

$\frac{1}{8}$"
$\frac{1}{2}$"
$\frac{3}{32}$"

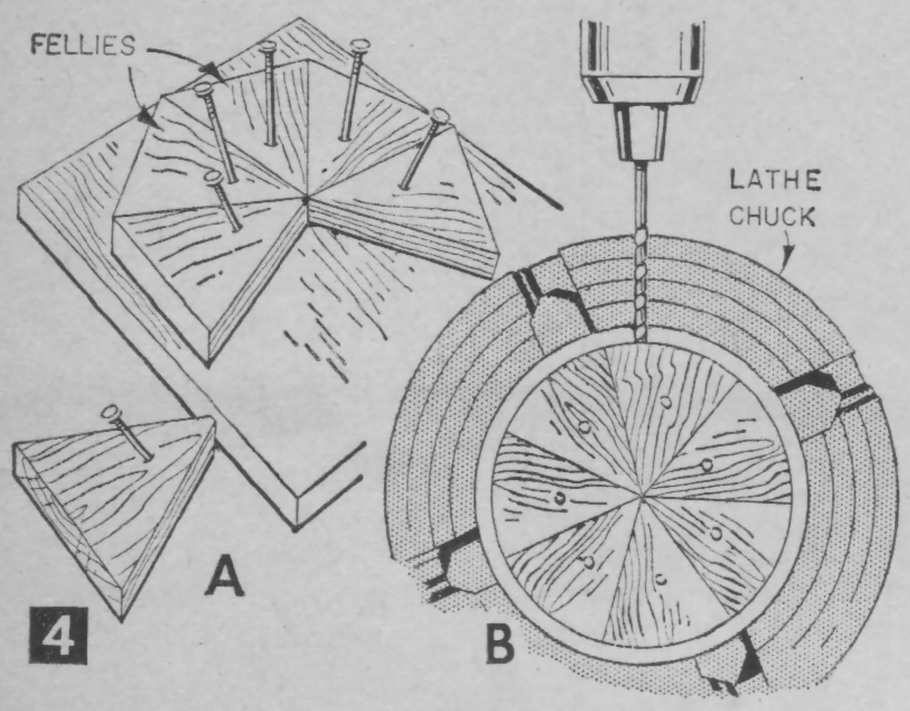
CLEATS
.040 BRASS
2 REQ.

$\frac{3}{16}$"
#60 DRILL
$\frac{3}{8}$"
$\frac{1}{8}$"
$\frac{1}{16}$" DRILL

CHAIN RING
.040 BRASS
1 REQ.

Construction. Starting with the wheels, bend two .032-in. thick strips of brass 7/32-in. wide by 11¼-in. long to circular shapes for the wheel rims or tires. Lap the tire strips ¼ in. and solder. Then file the lapped ends to make the joints smooth.

The wheel fellies (Fig. 3) are made from seven triangular segments glued together as in Fig. 4. When cutting the segments from ¾ x 2⅛ x 18-in. walnut stock, set the miter gage on your circular to 64¼° and flop the stock over after each cut so all of the segments can be cut with the same miter gage setting. Although only seven segments are needed for each wheel, cut about 16 segments so you will have a couple extras in case some do not fit together too well. Then drill a hole in each segment slightly smaller than a 1¼ in. nail to hold each group of ¾ x 5 x 5-in. plywood as in Fig. 4A until the glue dries. Drill these holes at about a 15° angle toward the center of the segments so the nails



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will tend to draw the segments tightly against each other. Allow glue to dry over night and then rough cut both the segments and the plywood backing to 4-in. dia. discs.

If you are using a metal turning lathe, chuck the plywood disc in a 3 or 4-jaw chuck for turning. If you are using a wood turning lathe, center and fasten the plywood disc to a lathe face plate with ¾-in. wood screws. Then rough turn the entire assembly and finish turn the segments to a drive fit with the tire. Do not, however, mount the tire on the segments at this time.

Since the fellies on the finished wheel are only 7/32-in. wide, score a line 7/32 in. from the face of the segments and mark a pencil centerline all around dividing the 7/32-in. width of the fellies. Then remove the assembly together with chuck or face plate from the lathe and divide the turned edge of each segment into four parts, marking the three dividing lines across the penciled centerline. Now, using the first and third dividing lines on each segment for wheel-spoke hole locations, drill 3/32-in. holes about ½-in. deep toward the center of the segments as in Fig. 4B.

Next place the chuck or face plate with attached segments back on the lathe and tap the wheel tire on the segments, coring the drilled holes. The tire will keep the fellies in place after they are turned off the segments. Bore the segments so that the I.D. of the fellies will be 3 1/16 in. as in Fig. 3, and cut them off 7/32-in. wide or flush with the tire. If you should run into trouble with the fellies falling apart, reglue them within the tire. Follow the same procedure when making the fellies for the second wheel.

For wheel spokes, cut 28 pieces ⅛ x 3/16 x 1 13/32-in. from maple stock and file them oval shape as in Fig. 3. Be sure to leave the corners square at one end of the spokes for attaching to the wheel hubs. Sand the spokes and file a 3/32 in. dia. tenon at the other end for attaching the spokes to the drilled holes in the fellies.

Make up the brass bands for the wheel hubs before turning the wooden hubs to shape. Use 1/32-in. thick by 3/32-in. wide brass strips for the bands and lap the ends about ⅛ in. for soldering. Then file the joint smooth. Note in Fig. 3 that each wheel hub is made up of two pieces.

When assembling the wheels, lay out a 3½ and a ⅝-in. circle on a piece of cardboard. Cut out the ⅝ in. circle and insert the large part of the wheel hub. Center the wheel tire and fellies assembly in the 3½ in. circle and tape in place. Then, with a tweezers, assemble each wheel spoke with glue to fellies and wheel hub. After all spokes are in place, glue the other side of the hub in place. Make the wheel nuts (Fig. 3) from 1/16 x 1/16-in. squares cut from .040 in. thick brass and indent each square with a small nail set to simulate the end of a bolt. Glue these nuts to the inside rim of fellies as in Fig. 3 to complete the wheel.

Axle Assembly. Make the axle bed from walnut as in Fig. 3. Although we used ⅛-in. square brass bar stock and turned the ends for the axle (Fig. 3), you could simply use a ⅛-in. round brass rod if square stock is not available. Drill a #51 hole in the center of the axle and fasten to the bed with a brad. Bend the two bed bands to fit in the ends of the beds and fasten with brads. Then make the axle washers and linchpins as in Fig. 3 and temporarily assemble the wheels to the axle to see that everything fits well.

Trail Assembly. Cut the trail (Fig. 3) from 7/16-in. walnut. The lunette, which is made up of three pieces as in Fig. 3, fits on the end of the trail. Turn the rig of the lunette from ⅛-in. thick brass and fasten to the pieces of 1/32-in. sheet brass with 1/16-in. brass rivets. File the hand spike rings to shape from ⅛-in.

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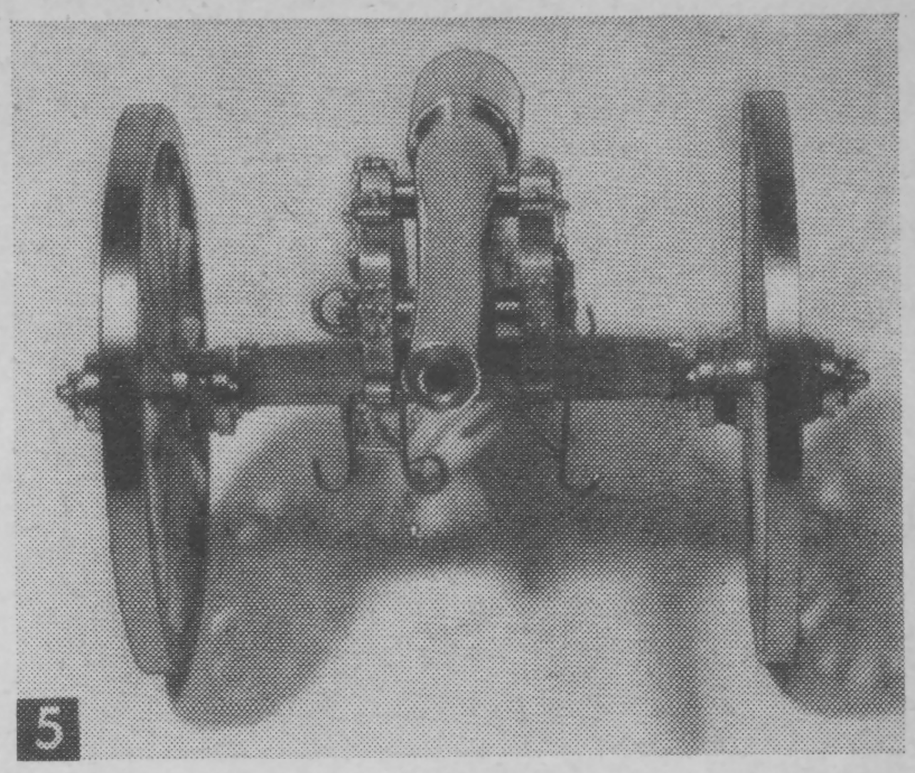
thick brass and fasten together with the lunette to the end of the trail as in Fig. 3 with brads. When making the lifting grips (Fig. 3) flatten the ends of the brass wire with a hammer and punch the holes with a sharp prick punch. This method works better than drilling because it spreads the metal and none is lost as in drilling. This same method applies to making eyelets, linchpins, cleats, straps and other small pieces of brass. Make the rub plates, cleats and chain rings as detailed in Fig. 3 and fasten to the trail as in the trail assembly drawing.

The rammer strap is assembled from 2 strap hangers, 14 flat links and 18 oval links as in the assembly drawing Fig. 3. For the oval links, take a #10 brass chain apart and flatten the links slightly with a pliers. Make the flat links from a 5/64-in. wide strip of .010-in. brass shim stock and bend the ends of each link (detailed in Fig. 3) around the oval chain links. Fasten the 7/16-in. long center link betwen the sets of 8 flat and 9 oval links. Fasten the strap links at each end of the assembled rammer strap.

To attach the rammer strap to the trail, make up the 0-80 stud and studs nuts, and insert through a hole located as shown in the trail assembly (Fig. 3). Then attach the strap hangers to opposite ends of the stud with wing nuts and fasten the center link to the underside of the trail with brads. Turn the elevating screw and file its base to shape as in Fig. 3 and fasten to the trail with brads.

Cheek Assembly. Draw and cut out a paper pattern of the cheek from the squared drawing in Fig. 3 and use it to draw the outline of two cheeks on 1/32-in. walnut. Cut to shape with a jigsaw. Now, using the axle bed as a placement guide clamp the trail to one of the cheeks and drill three #40 holes through the cheek in line with those in the trail. Drill the other cheek the same way. Then make the cheek studs and spacers and the chain hooks as in Fig. 3, and assemble the cheeks to both sides of the trail with the spacers between the trail and cheeks. Chain hooks A serve as washers on each end of the rear cheek stud. Chain hook B goes on right side of center stud. Use brass washers on other studs.

Make one trail strap and two cheek straps from strips of brass as in Fig. 3, and carefully form strips of brass around the tops and front edges of the cheeks, bending the strips to form the lower half of the trunion bearings. Use a scrap piece of 3/16-in. dia. rod to form the trunion bearings. Bolt the cheek straps and strip across the top of the cheeks with three 0-80 brass bolts as in the cheek assembly drawing (Fig. 3). Two ¾, 1, and 1¼ in. long bolts will be needed. To fashion the trail strap and forward ends of the cheek straps, turn down the heads of six #2 x 3/8 in. brass wood screws to .060 in. dia. and thread for



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Front view of model gun showing location of right and left side rammer hooks.

0-80 hex nuts. Drill pilot holes for these screws and use two nuts on threaded end to drive them into the wood. Then fasten straps in place with one nut on each screw. Fasten the rammer hooks to the bent front ends of the cheek straps as in Fig.

We sawed and filed the trunion caps (Fig. 3) to shape from solid brass stock, however, they could also be bent to shape from strip brass. Make the cap locks and drive them through the strip on the cheeks so that the slots in the caps will slide over the cap locks. Eye pins made of 1/16 in. brass rod as in Fig. 3 and fastened to eleven links of #21 chain are inserted through the holes in the cap locks as in Fig. 3 to hold the trunion caps in place.

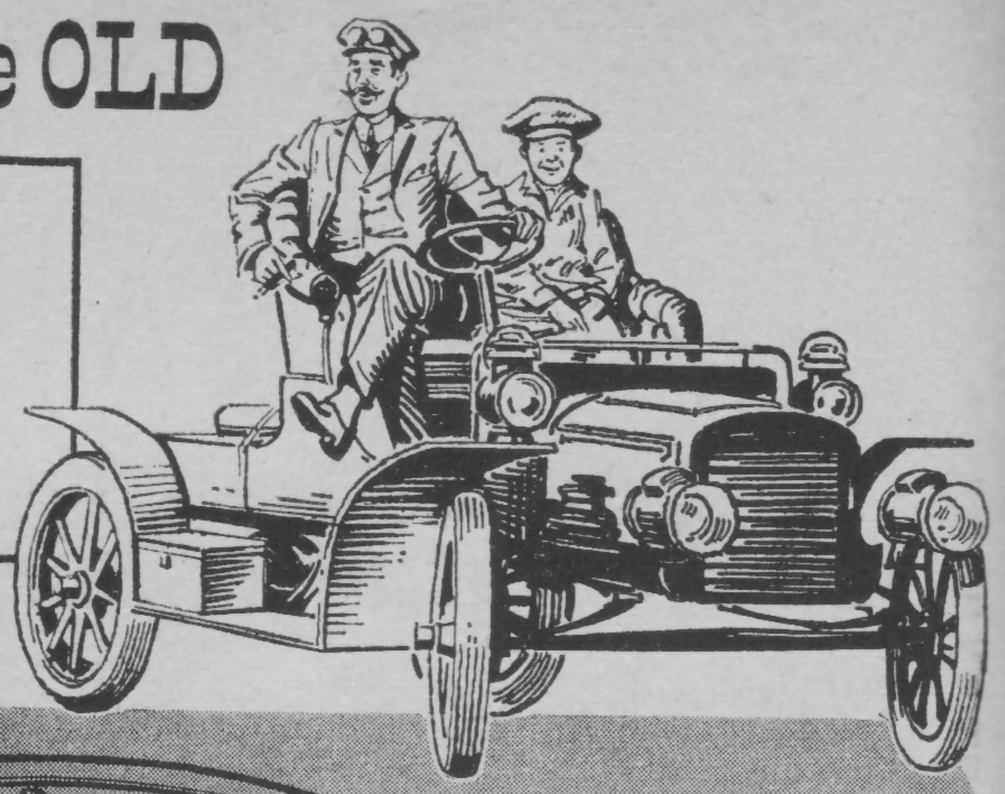
Barrel. Turn the barrel to the dimension given in Fig. 3 from a ¾-in. brass rod 7-in. long. Drill a ¼-in. hole through the barrel for the trunion and turn the trunion for a press fit in the drilled hole. To simulate the rifling in the bore of the barrel, make a broach from a 4 in. length of ¼-in. drill rod as in Fig. 3. After turning the four rings from .195 to .210 in. as in stage 3, mill five 1/16 x .025-in. deep grooves equally spaced around the rod cutting through all four rings. Harden the broach by heating it to a cherry red with a torch and quench in oil. Then tempor it by first polishing a bright spot on it with emery cloth and reheat it with a torch. When the bright spot turns to a light straw color quench the broach in water.

With the barrel chucked in the headstock of your lathe and the broach chucked in the tail stock, force the broach in and out of the bore. Use plenty of oil when broaching the bore. The simulated rifling will have fire lands and grooves and be very realistic.

For a finish, use a sanding sealer on all of the wooden parts. Then, after all the brass parts are polished, give the wood and metal parts two coats of lacquer.

If you remember the OLD

SCIENCE and MECHANICS



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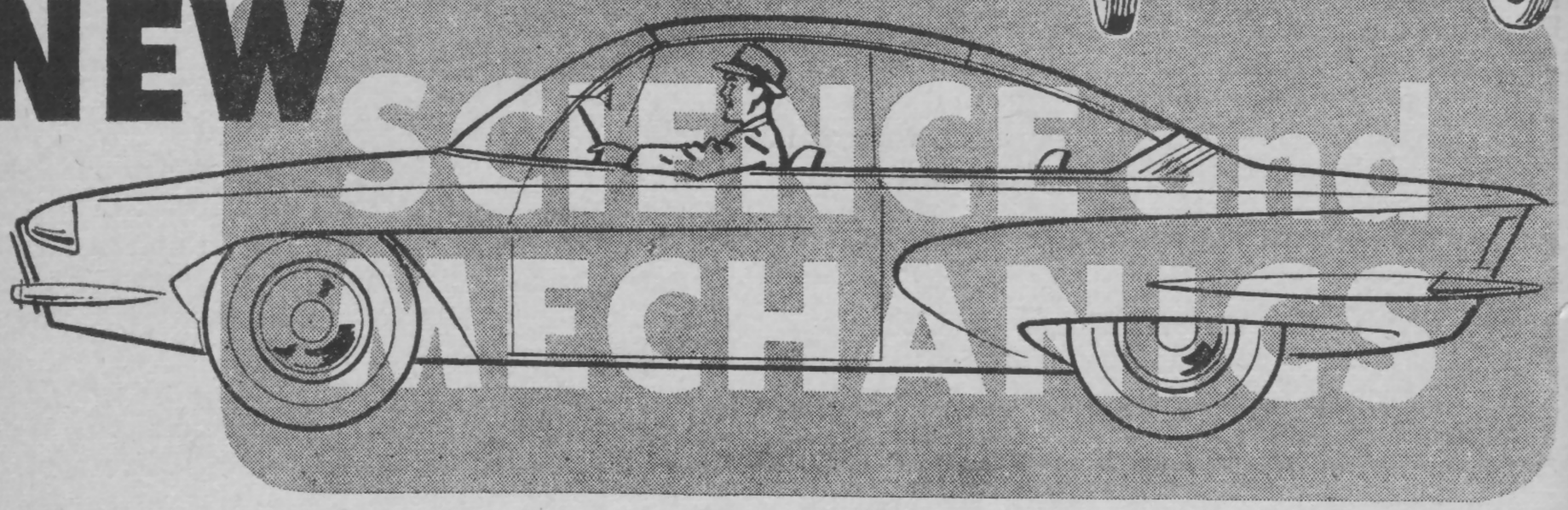

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BE TODAY

NCE AND MECHANICS

Refinishing Old Hardwood Floors Without Sanding

• How to mix and use a time-tested formula employed by floor-maintenance contractors to clean and brighten wooden floors

• Spot-cleaning and refinishing worn areas to match the rest of the floor

• How to repair deeply burnt, cracked or uric acid stained floor boards

By HAROLD K. PENNINGER

ONE way of finding out if your hardwood floor is in need of refinishing is to lift a corner of the rug and notice the difference between exposed and protected parts of the floor.

The method you then use to refinish the floor depends upon the condition of the finish on your floor. For example, if your floor has always been maintained by dusting or vacuuming and rewaxing, the original finish is probably in good shape and the darkened appearance of the floor may be due to dirt and grime embedded in the layers of old wax only. Removing the old wax and cleaning the original finish usually lightens and brightens such a floor.

1

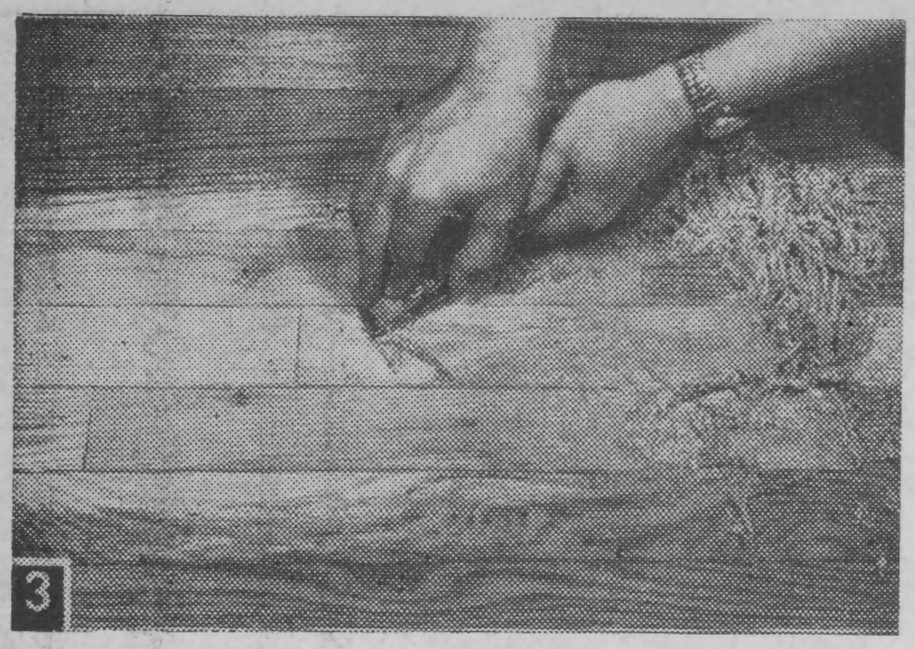
Evidence of the cleaning action of this safe yet powerful bleach-cleaning formula is shown by comparison between cleaned and uncleaned areas of the floor above.

2

Paste wax polished with an electric floor polishing machine provides the most durable and lasting protection for hardwood floor finishes.

If, on the other hand, your floor has been maintained by mopping and washing with water and detergent, the original finish has probably been washed off in places and the dirt and grime embedded in the finish and wood itself, turning it to a dirty gray. The only way to refinish such a floor is by using the floor cleaning formula described later.

Removing Old Floor Wax. Use turpentine or oil-paint thinner (sold under various trade names as an inexpensive substitute for turpentine) and #2 steel wool to remove old floor wax. Dip a pad of steel wool into the paint thinner and hand scrub the floor, working on a small area at a time. Wipe up the dirty, dissolved wax with clean rags and go



Hand scraping will remove stubborn stains and dirt embedded in the surface of worn spots on a wooden floor.

Left, Painter's tube oil colors mixed with turpentine are used to make a stain to match worn spots with rest of floor. Above, Using a rag to apply matching stain to a cleaned area of floor.

to the next section. If a grayish film remains on the floor after it dries, wipe it clean with more rags. Do not dampen the rags with water, and be sure to burn them outdoors when finished because they could become a fire hazard if left in a pile.

Inspect the original finish on the floor as you are scrubbing it. If it does not appear worn and the floor turns out uniformly lighter and brighter, rewaxing will finish the job. If the finish is worn in places but the wood beneath not discolored, give the floor one coat of the same finish used originally. See text under "Types of Floor Finishes," if you do not know the kind of finish that was used originally.

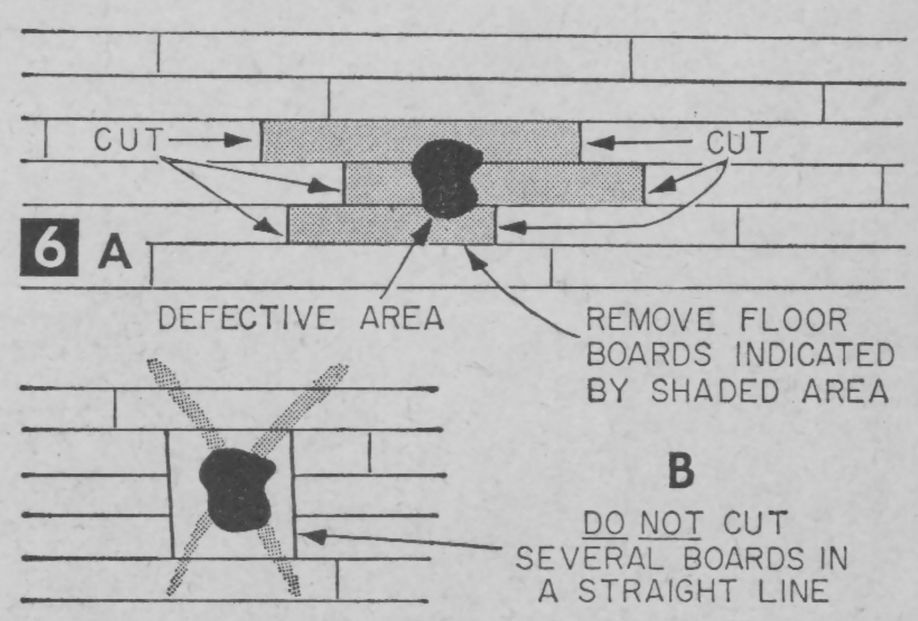
Mixing and Using the Cleaning Formula. First dissolve one cupful of oxalic acid crystals in two quarts of warm water. Use rubber gloves while stirring and then add one quart of wood alcohol or shellac solvent to the mixture. A stronger solution, using only one quart of water, may be needed for exceptionally dirty floors.

Wear rubber gloves and use a wad or pad of #2 steel wool saturated with the solution to hand scrub the floor. Work on a small area of the floor at a time as in Fig. 1, occasionally dipping the steel wool in the solution so that you have plenty of it on the floor as you scrub. The alcohol will soften the finish, particularly if it is varnish or shellac, so that some of the finish along with the embedded dirt can be removed. The oxalic acid will bleach the stained and discolored floor boards. Wipe the area clean with a rag wrung out in a pail of clean warm water.

After the floor has dried thoroughly, hand sand it lightly with #0 sandpaper and remove the dust with a vacuum cleaner in preparation for the new finish.

Types of Floor Finishes. Your best choice of floor finish would be two coats of the same type of finish used originally. The difficulty, of course, is in determining which type of finish was used. It could have been varnish, lacquer, penetrating floor sealer, or in some cases, shellac.

Generally speaking, a varnish, lacquer or shellac finish will have a glossy appearance as compared to floor sealer which has a dull or satin-like appearance. However, since you have cleaned the floor



with steel wool, you may have dulled an otherwise glossy finish to the point where it would be very difficult to tell by this method unless you are a professional floor refinisher.

Another method of determining the type or original finish used is to attempt to remove a small portion of it with a known solvent. Select a spot on the floor where the original finish has been protected with a rug and is still in good condition. Saturate a small piece of cloth with alcohol and rub it across the finish. If, after a minute or so, the finish softens so that you can remove some of it, the finish is probably varnish or shellac. If the alcohol does not soften the finish, try some lacquer thinner. Softening of the finish with lacquer thinner indicates the finish is lacquer. Do not, however, use lacquer thinner before trying the alcohol because the thinner will also soften varnish.

If neither alcohol nor lacquer thinner softens the finish, it is probably penetrating floor sealer. A further test is to hand sand a sm ing does not remove th the finish has penetrat wood as a sealer does.

Lacquer should never a cleaned floor unless lacquer was used origin cause the old finish (oth blister.

Although penetrating ish to use on a new floor oughly and remain tack floors finished originall filler and varnish. If, h sealer was used on the sealer is the best to use

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Preserving the Finish.

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small piece of cloth with alcohol and rub it across the finish. If, after a minute or so, the finish softens so that you can remove some of it, the finish is probably varnish or shellac. If the alcohol does not soften the finish, try some lacquer thinner. Softening of the finish with lacquer thinner indicates the finish is lacquer. Do not, however, use lacquer thinner before trying the alcohol because the thinner will also soften varnish.

If neither alcohol nor lacquer thinner softens the finish, it is probably penetrating floor sealer. A further test is to hand sand a small portion. If sanding does not remove the finish it indicates the finish has penetrated deeply into the wood as a sealer does.

Lacquer should never be used to refinish a cleaned floor unless you are certain that lacquer was used originally, because it may cause the old finish (other than lacquer) to blister.

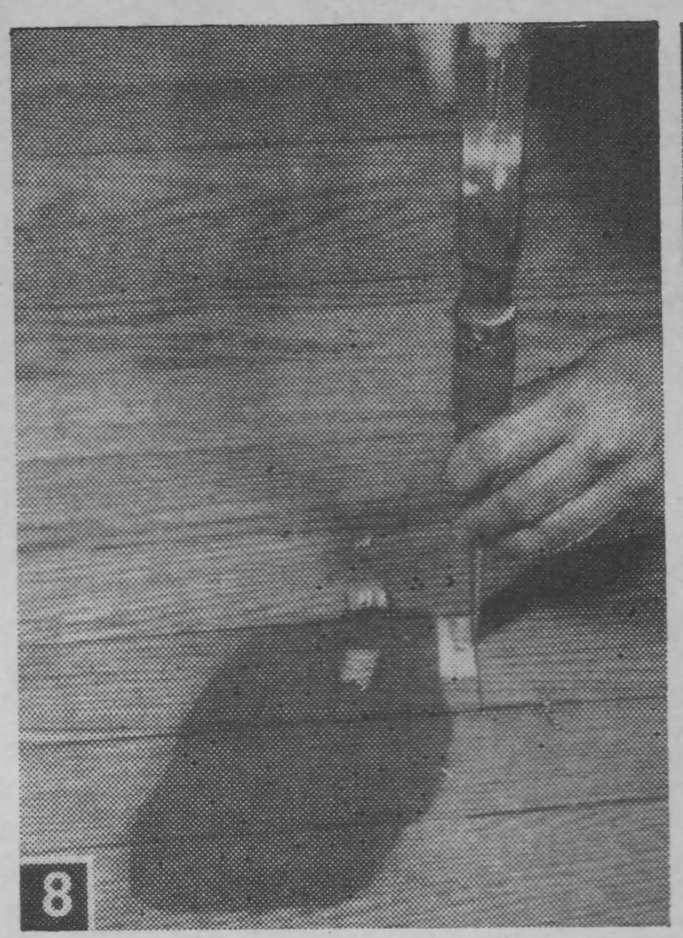
Although penetrating sealer is an ideal finish to use on a new floor, it may not dry thoroughly and remain tacky on bleach-cleaned floors finished originally with paste wood filler and varnish. If, however, penetrating sealer was used on the floor originally, then sealer is the best to use for refinishing.

When in doubt as to what the original finish was, a quick-drying floor varnish can be safely used regardless of the type of finish previously used

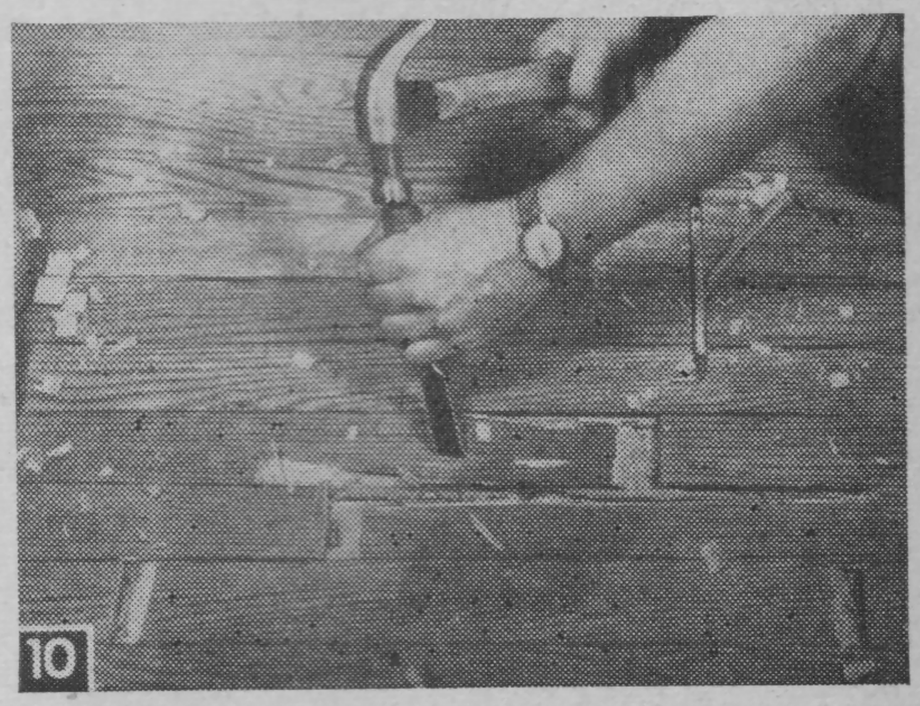
Preserving the Finish. A protective coating of floor wax and frequent cleaning with a dust mop or vacuum cleaner is the best way of preserving the finish on a floor. Repeated washing with water and detergent will break down the finish and eventually cause the floor to turn a dirty gray.

Either liquid or paste floor wax may be used to protect the floor finish. Each has its advantages and disadvantages. Although liquid floor wax can be applied easier and faster than paste wax, the thin film of wax deposited does not provide as much protection to the floor finish as the heavier coat of paste wax does, and therefore requires more frequent application. About once a week on traffic areas through halls and in front of doorways will assure floor protection in most homes.

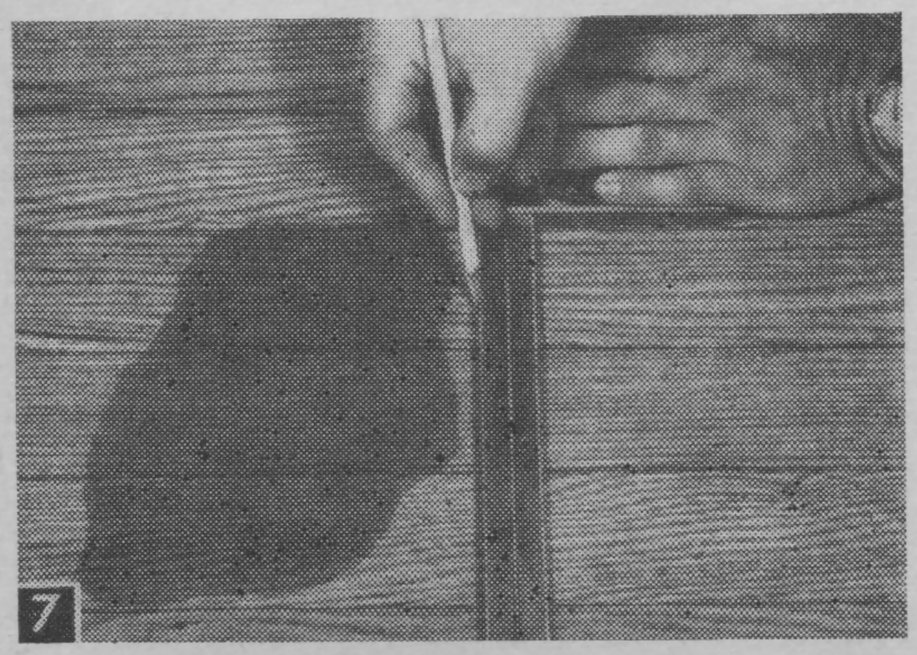
Paste wax, although more durable than liquid wax, has the disadvantage of making the floors slippery. This can be overcome to



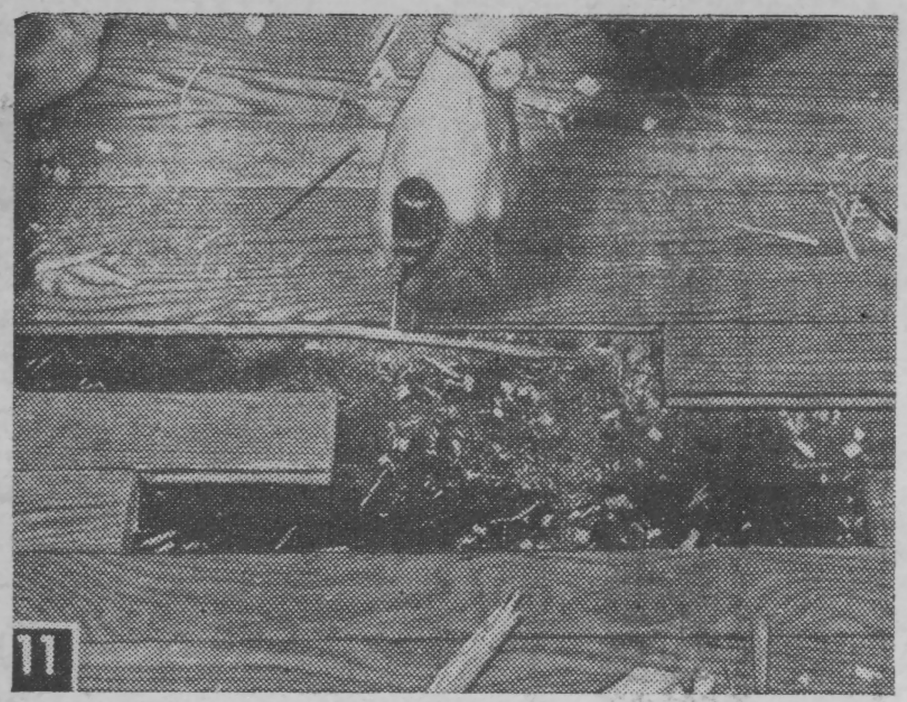
Left, Make vertical cuts first by holding chisel perpendicular to floor with beveled edge toward defective part of floor board. Right, To provide clearance for blade of chisel for further vertical cutting, remove wedge-shaped chips to depth of cut.



Remove the defective board by splintering it into small pieces.



Mark cutting line prior to removing a defective floor board with a square to assure a neat, tight joint with new board.



Cut the tongue from adjoining floor boards to provide clearance for new board.

a certain extent by using throw rugs with non-slip rubber pads beneath them along traffic lanes. Paste wax which is hard and resists finger pressure in the can will wear longer than the softer, mushier types of paste wax. Apply to the floor with a dry cloth and after allowing it to dry 20-30 minutes, polish with an electric polisher as in Fig. 2.

To remove black marks on a floor from furniture casters or rubber heels, dip a pad of #0 steel wool in paste wax and rub it across the marked spot. The wax will dissolve the dirt so it can be picked up with the steel wool.

Spot Refinishing Worn Areas. Worn and water stained areas in front of doors, on stair treads and halls need special refinishing treatment to make them blend into the rest of the floor. Start cleaning these areas with the one-quart-water mixture of the bleach-cleaning formula. Vigorously rub the gray-stained areas with the steel wool to remove the embedded dirt and all traces of the finish so that the bleach will contact the wood. Since the bleach requires 10-15 minutes to lighten the wood, do not wipe the floor dry too quickly. Repeated applications may be needed in some cases. After the spot has dried thoroughly, which may require several hours, inspect the worn area to see if all embedded dirt and grayness have disappeared.

If you are not satisfied with the appearance of the worn areas after cleaning, hand sand or hand scrape the spot as in Fig. 3. A portable electric belt sander or disk sander used with the grain of the wood will work if care is taken not to gouge the wood. Reduce pressure on the sandpaper at the edges of the worn areas to "feather" the sanding gradually into the old finish.

Spot Finishing. Since the wood and finish of an old floor darkens with age, you will have to mix a stain to match the color of the floor surrounding the cleaned spot. Pour about ½-cupful or less of turpentine in a shallow pan and add about 2- or 3-in. of raw sienna oil color as it comes from the tube (Fig. 4). Mix thoroughly and apply sparingly with a rag to the edge of the sanded spot next to the old finish as in Fig. 5. If the stain is too light, add more raw sienna or raw umber. Continue adding color and testing until you have a mixture of the proper shade. Floors that are very dark may require burnt sienna or burnt umber oil colors to darken the stain. If you are sure that penetrating floor sealer was used for the old finish on your floor, clear sealer can be substituted for the turpentine to make up the stain.

Apply the stain with a rag and evenly to the entire area. Let it stand a few minutes, then wipe off excess stain with a clean rag, rubbing with the grain of the wood. Re-apply the stain and wipe it if necessary to darken the area. Allow stain to dry at least 12 hours; then gently rub with #00 steel wool, sweep to remove dust, and apply two coats of floor varnish.

Brush the varnish on evenly from the mid-

Plane the tongue off the new board and bevel the bottom edges of both sides slightly so new board will fit snugly in place.

dle of the area and across the floor boards in both directions, lifting the brush at the edges so that the varnish just barely overlaps the old finish. If the varnish appears too glossy as compared to the old finish, dull it down with steel wool before waxing.

Repairing Burnt or Acid-Stained Spots. Regardless of how often or much you clean, bleach, sand or scrape the floor you cannot remove a deeply burnt spot near the fireplace or a uric acid stained spot caused by a pet. The only remedy is to remove and replace the defective floor boards with new ones. A cracked or splintered board must also be replaced if a permanent job is wanted.

First check to find out what kind of wood was used for your flooring. It probably is red or white oak, or maple. Then, if possible, obtain old floor boards from a dealer in used lumber and remove the finish with varnish

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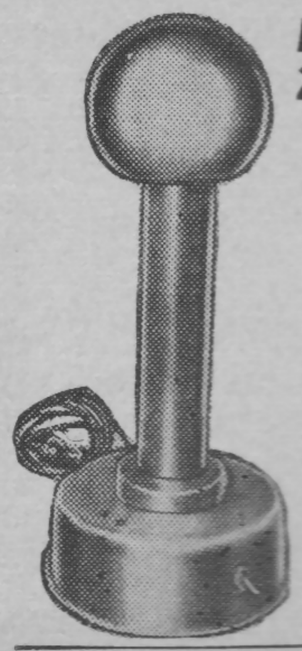
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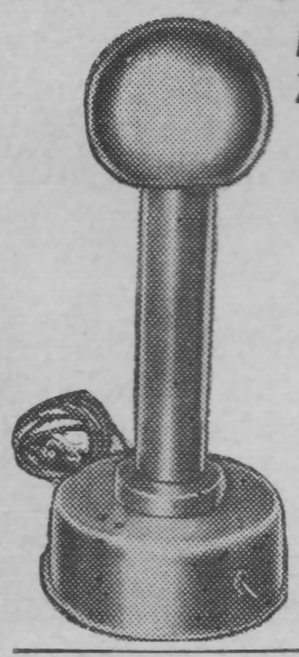

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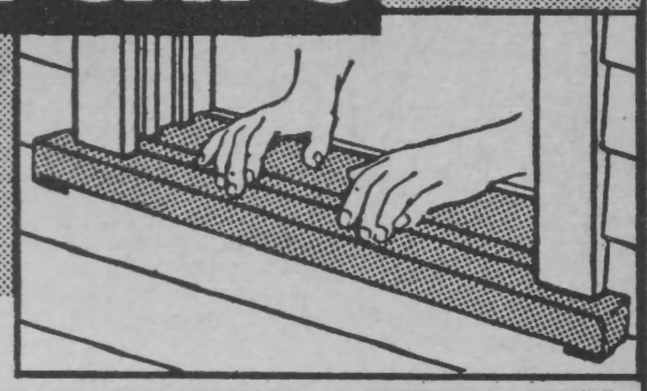

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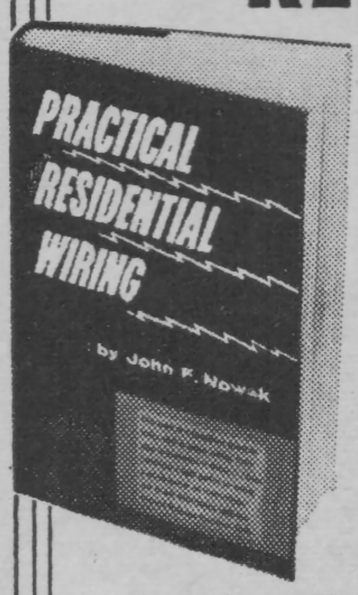

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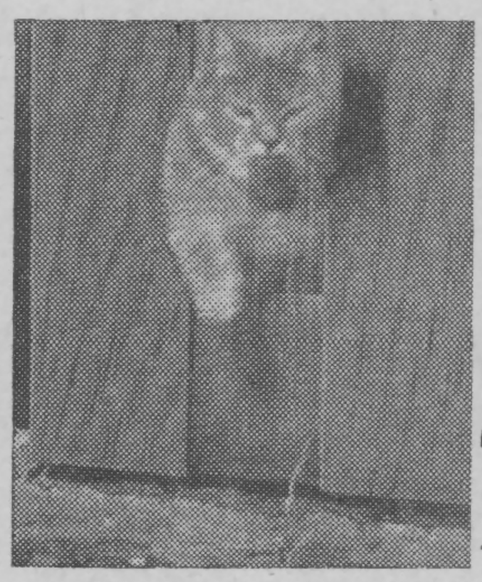
Lay out cutting lines at right angles to the grain of the floor boards as in Fig. 7 and be sure to stagger the cut edges from one board to another as in Fig. 6A. Never cut out defective floor boards as in Fig. 6B. Then, holding a 1-in. chisel perpendicular to the floor with the beveled edge facing the defective side as in Fig. 8, tap the chisel with a hammer cutting about ⅛ in. deep. Widen the cut by tilting the chisel to remove chips as in Fig. 9. Repeat this procedure until you have cut through the floor boards at each end. Do not, however, cut into the subflooring, which is under the top flooring.

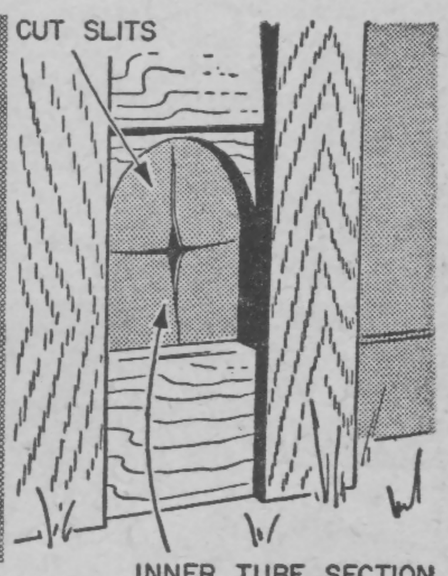
Even though the defective boards have been cut at each end they cannot be removed in one piece because of the tongue and grooves on adjoining boards. The only way to get them out is to split them into small pieces with the chisel as in Fig. 10 and remove the pieces. Then chisel the tongue off the adjoining pieces as in Fig. 11.

Now, accurately measure and saw the replacement floor boards to size and plane off the tongue as in Fig. 12. The boards should not fit too loosely. Use a scrap block of wood to take the hammer blows and drive the boards in place if necessary. Fasten the boards with 2-in. finishing nails, setting them about ⅛ in. below the surface.

It's a good idea to drill pilot holes for the nails to avoid splitting the boards. Use glazier's putty, tinted with raw sienna oil color to match the flooring, to fill the nail holes and any gaps at the sides or ends of the boards. Sand the replacement floor boards and finish with a matching stain and varnish as described for spot finishing.

Pet Entrance





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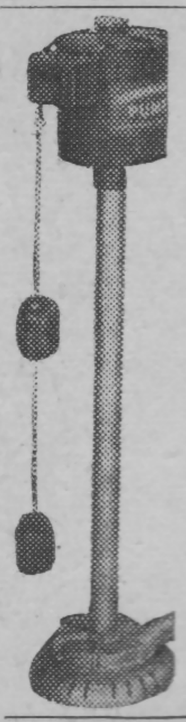

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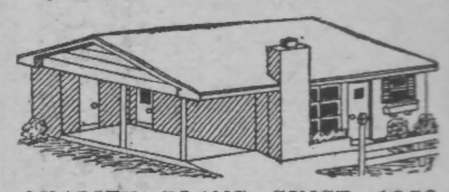

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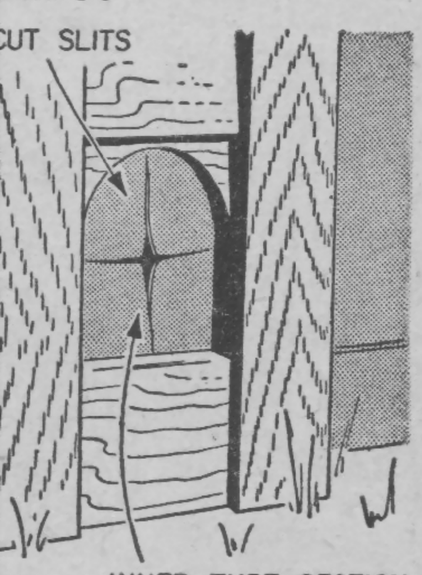

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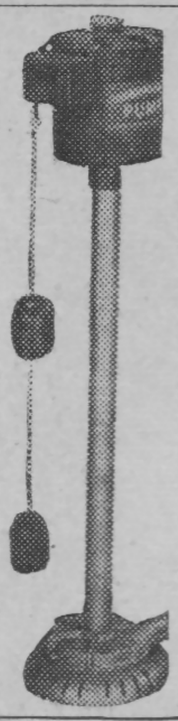

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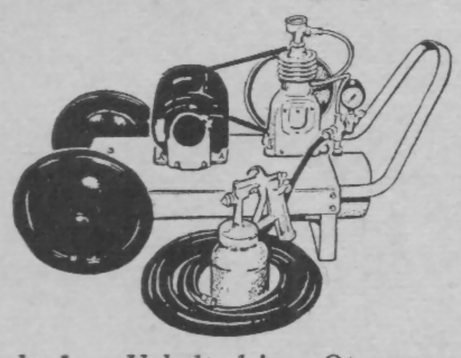

This dual purpose paint sprayer — complete with heavy duty 1/3 H. P. 110V 60 cy AC motor on wheels is a 90 day offer. It has a low 40 lbs. pressure for paint spray gun and a high 90 lbs. pressure for tires, lubrication, etc. Finest 1 cyl piston comp 2.8 cfm, mounted on 10 inch wheels, large air tank, dual pressure safety valve, air guage, cord and plug, V belt drive, Qt. spray gun. Dimensions 30"—18"—14". Shipping weight 80 lbs. F.O.B. Chicago.

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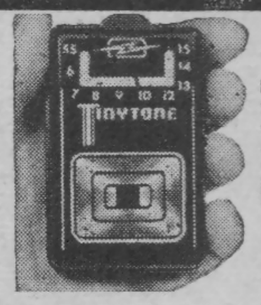

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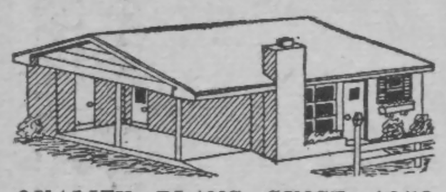

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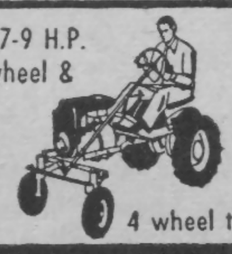

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WITH Roll-eez® Trade Mark SET "A"

ROLLER BEARINGS FOR WOODEN DRAWERS

Nail two Roll-eez "N" on rail at drawer opening. If drawer has center guide, nail third Roll-eez "N" on top of back in the middle, and Roll-eez "M" on bottom of back, straddling guide.

Eliminates friction of wood-against-wood, keeps drawers in proper alignment. Makes wooden drawers work like magic—*even in hot, humid weather!* Made with improved NYLON rollers mounted on steel frames. Each drawer set includes simple instructions and nails. Anyone can apply. Ideal for furniture as well as built-ins. Used by cabinetmakers to provide lasting convenience in homes of every price range.

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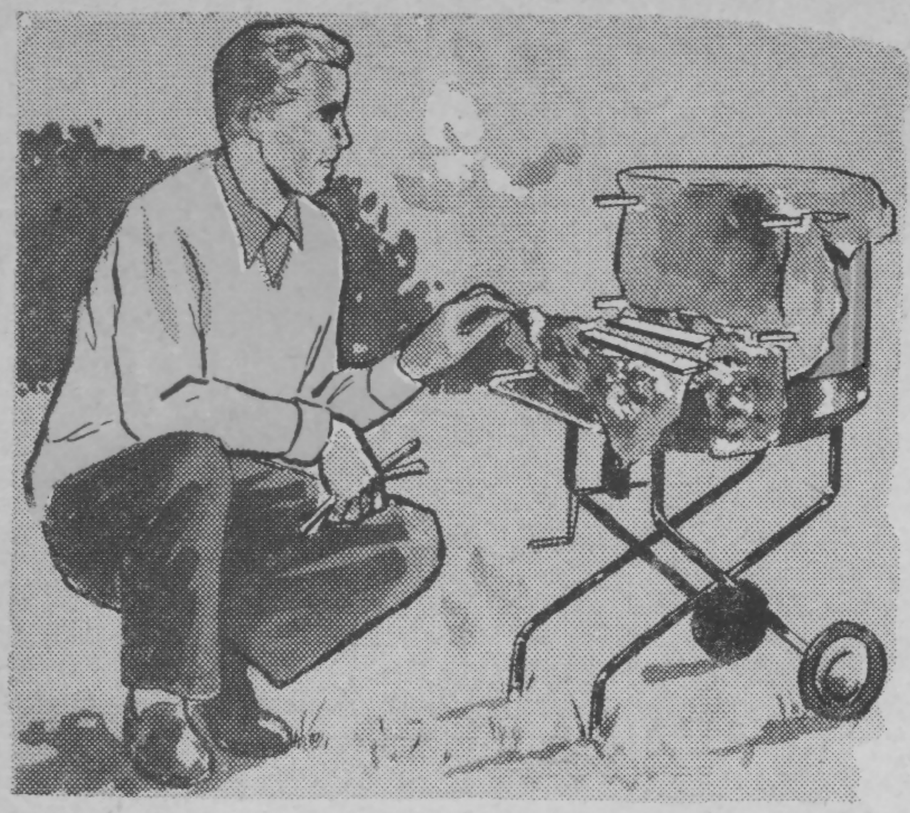
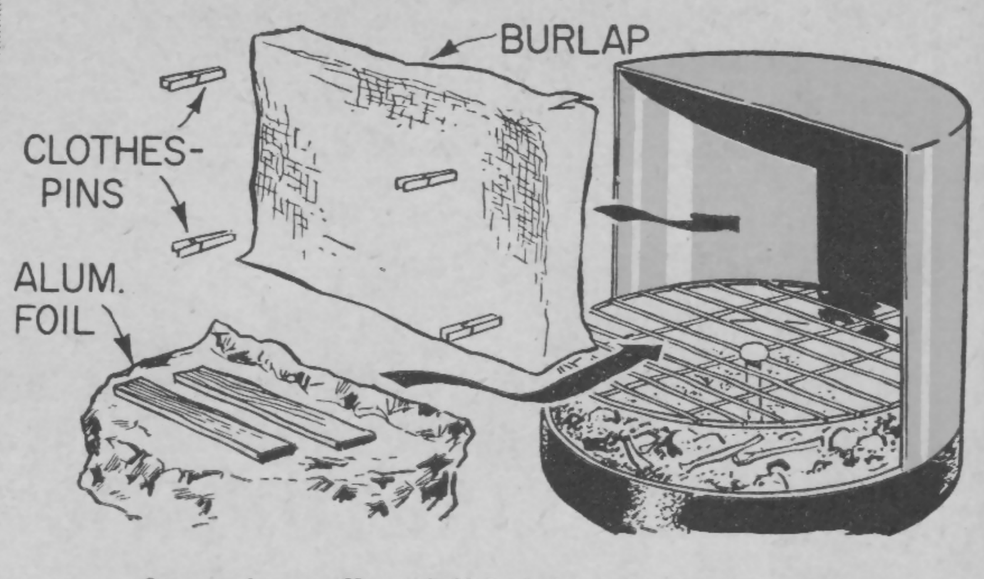
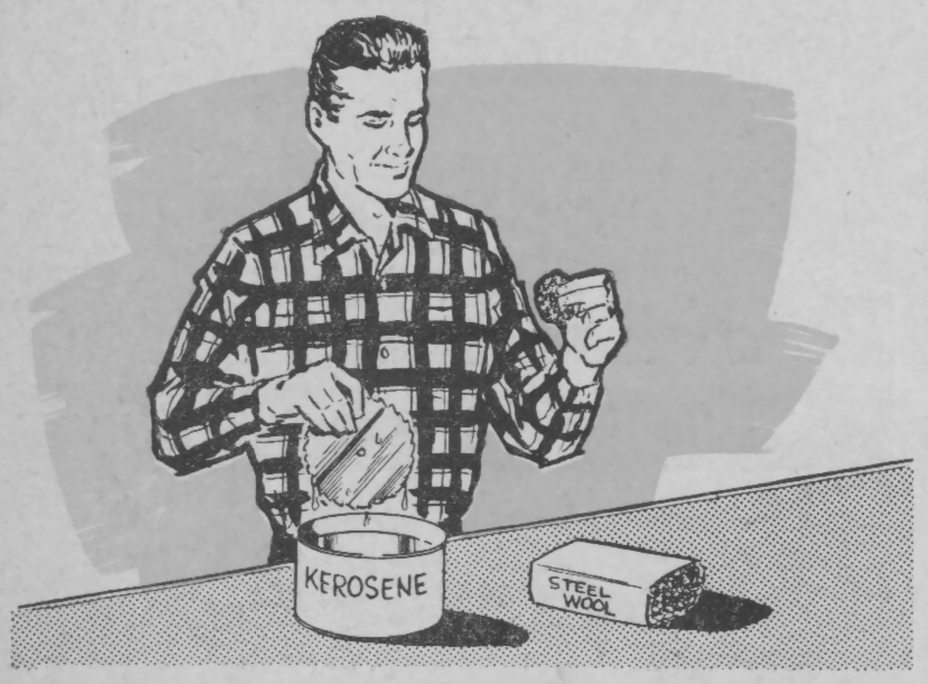
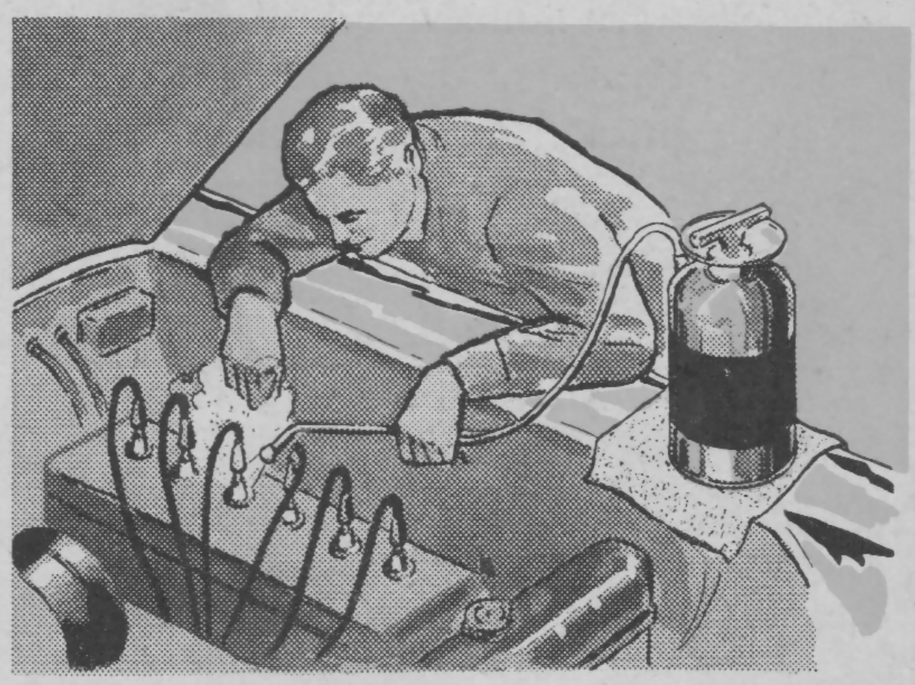




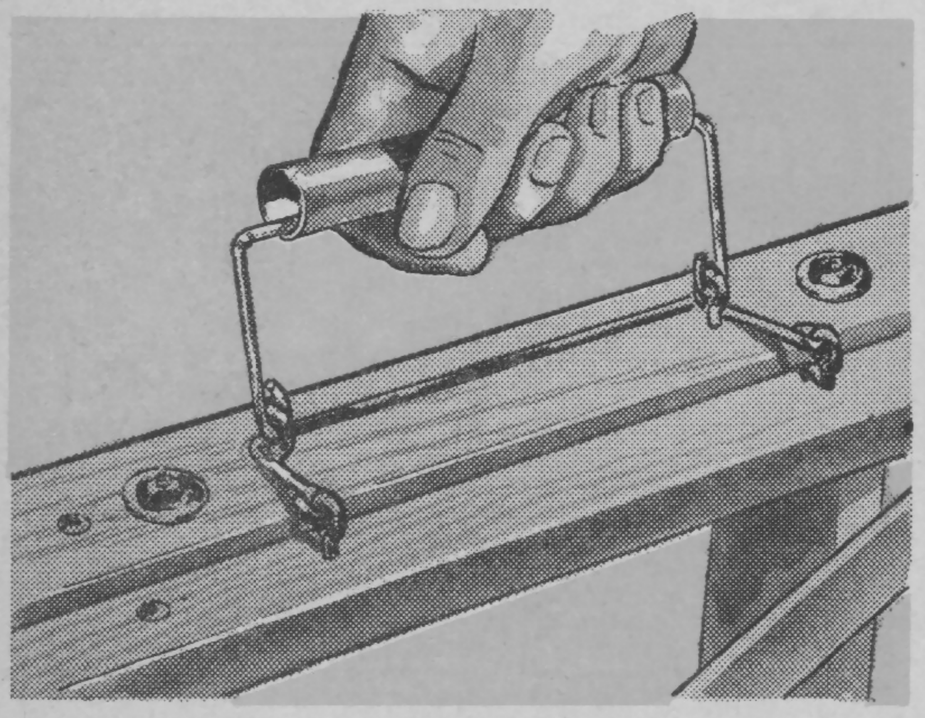
To use your portable barbecue as a smoker for fish or meat, first raise grill to full height. Build a hot charcoal fire in forward half of grill. Cover sides and top of forward half of grill to edge of hood with aluminum foil, leaving a flap in front for fire feeding. Lay fish or meat to be smoked on uncovered portion of grill inside hood. Stretch burlap sack over hood opening to form smoking chamber, holding in place with clothes pins. Add fruit wood, dry or green; hickory, birch, cedar bark or corn cobs for smoke. Do not use resinous woods.



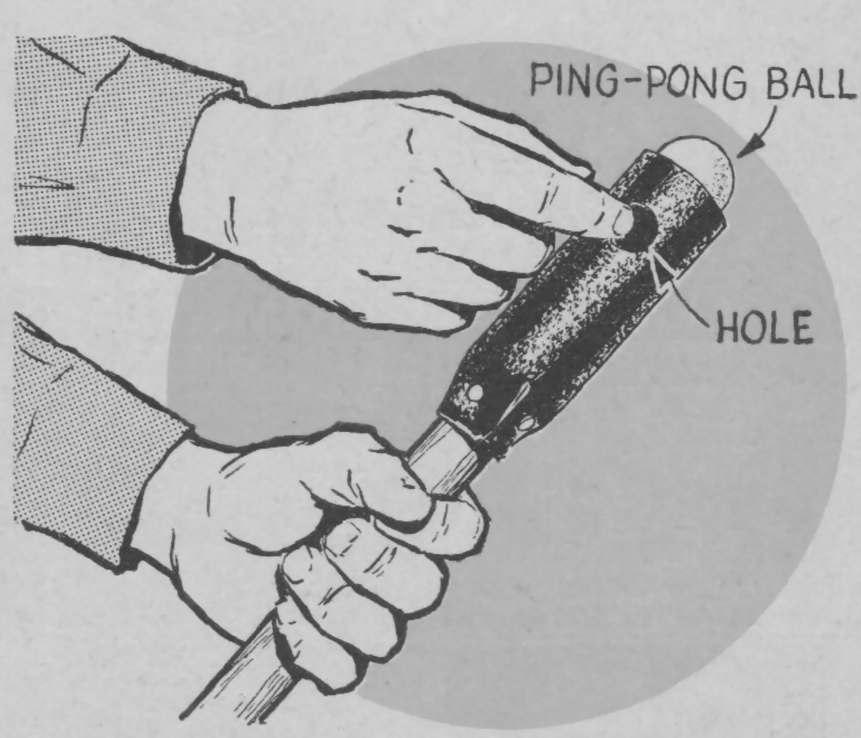
To remove gum from power saw blades, soak overnight in kerosene, then rub with steel wool.



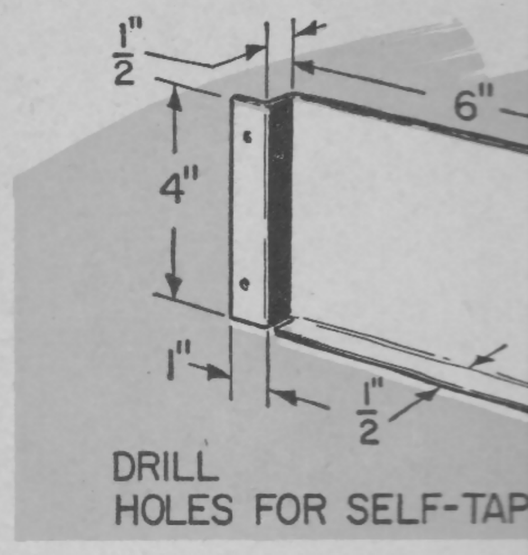
Use air from your garden sprayer to clear spark plug wells before removing plugs. Set nozzle at "jet".



A handle will ease the carrying of ladders, picnic tables, etc. Attach a pair of screweyes into each section of the ladder and form a hasp section of heavy wire. Slip a 4½-in. section of thinwall conduit tubing or heavy hose on another length of wire and fasten to remaining screweyes with an inward loop.



Rescue ping-pong balls from hard-to-get spots with a retriever made from a 4-in. length of 1½-in. I.D. radiator hose tacked to a 3-ft. length of broomstick. Cut a small finger-hole near lower end of hose to push ball out if necessary. In retrieving, press device tightly over ball to lift without losing.



Fasten this handy rack to the
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Fasten to back of TV in such
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Let the can of enamel stand in
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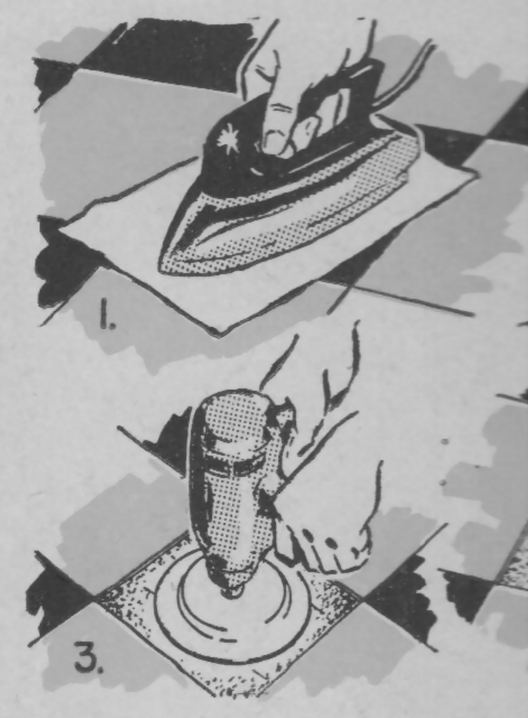

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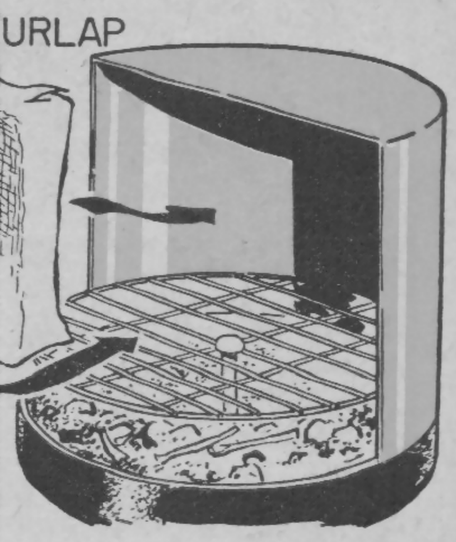

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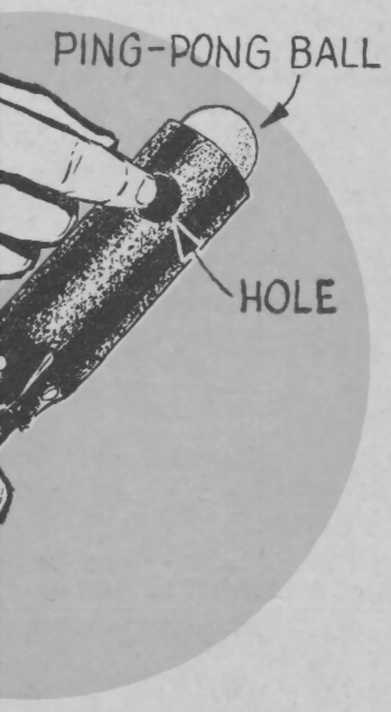

hard-to-get spots with a
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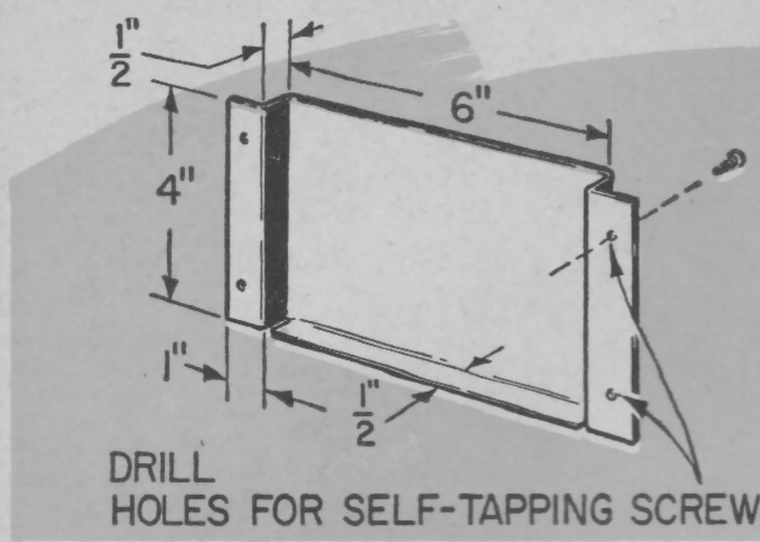
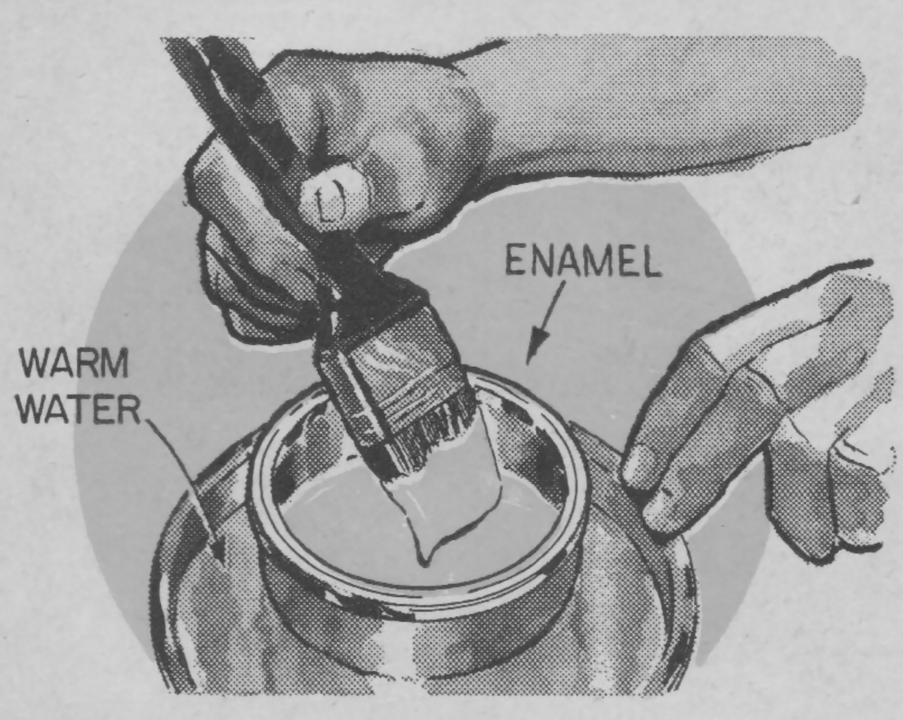
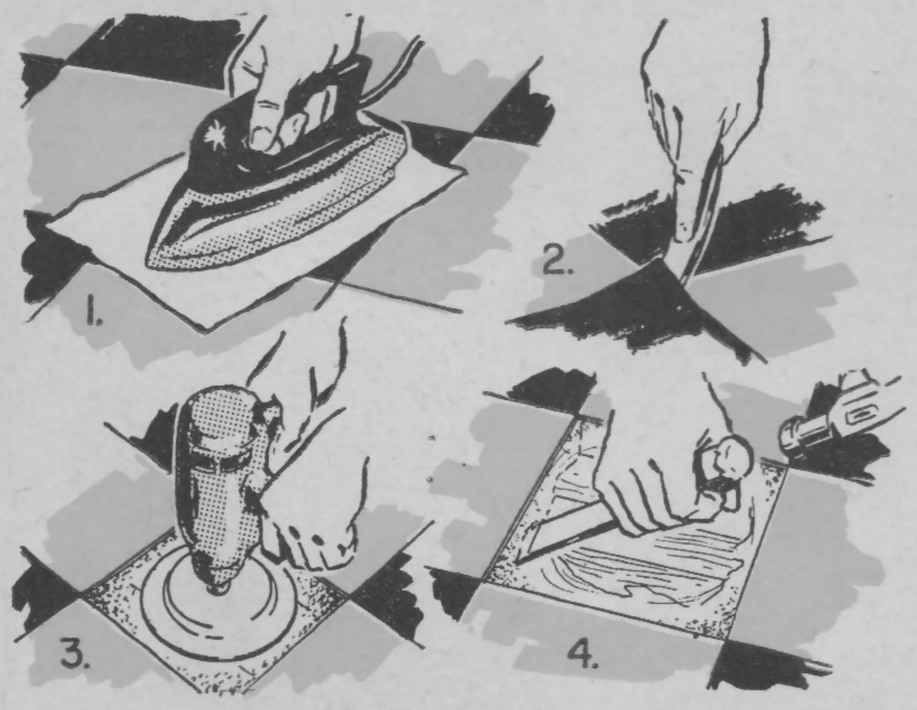


Fasten this handy rack to the back of your TV to keep that ever-lost schedule convenient though out of sight. To make, cut a piece of light weight sheet metal to the dimensions shown or alter dimensions so rack will conveniently take the schedule of your choice. Now drill holes, and make the three bends at points indicated. Fasten to back of TV in such a way that none of the ventilating holes provided by the manufacturer are covered. Otherwise you will shorten the life of your set's tubes, and there might even develop a fire hazard.



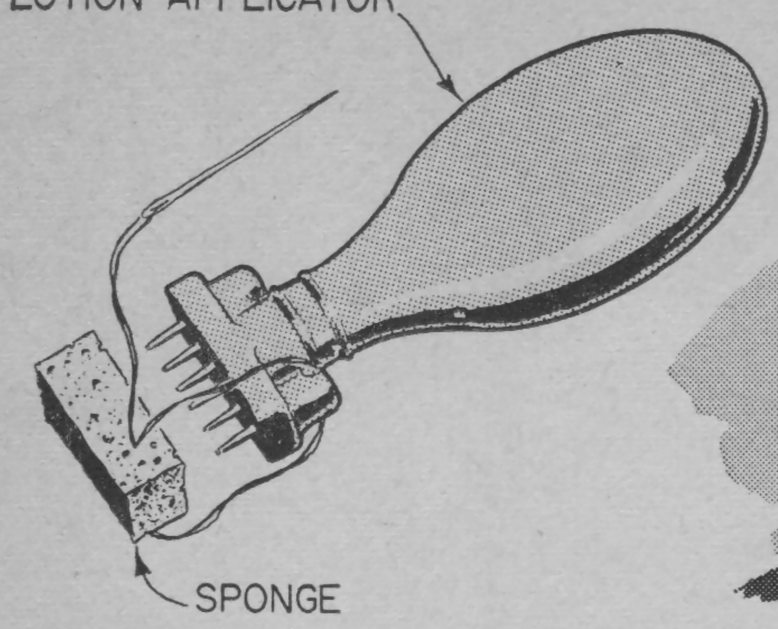
Let the can of enamel stand in hot water for a while before applying. Warm enamel flows on better.

To color shellac to any shade, slowly add spirit soluble aniline dyes dissolved in alcohol, then strained.



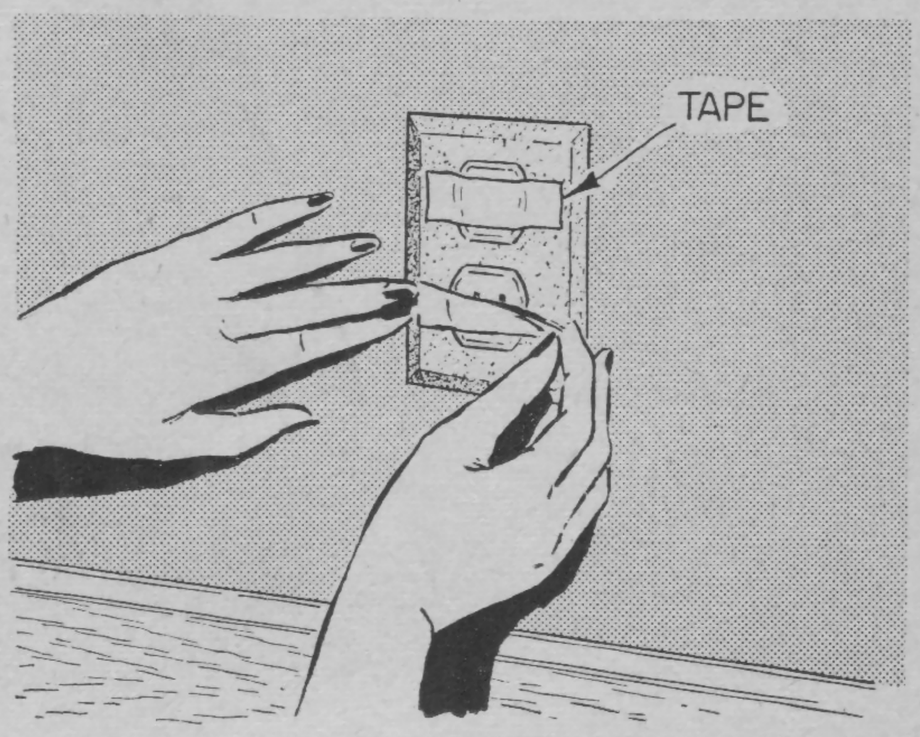
Remove rubber tile embedded in water-proof cement by laying a damp cloth over tile and heat with warm electric iron for a minute or two. Free tile with spatula. Remove remaining cement with 4-16 sandpaper on a rubber pad in a portable drill. Use a chisel and hammer near remaining tiles to prevent scoring.

To prevent your accidentally knocking over a pail or can of paint, screw a 1 x 2 x 8½-in. strip of wood to the top shelf of the stepladder. Use a single screw only, so you can swing the strip down out of the way when it is not needed. To use, drop the bail handle over the wood and your pail will stay in place.



The squeeze-type lotion applicator bottles included in some of the home permanent kits make handy envelope flap or gummed tape moisteners. Just sink the comb tip into a ¾ x ¾ x 2-in. piece of sponge and tie or sew in place. Fill the bottle with water, replace tip and squeeze to start the flow of moisture.

Use an empty seasoning or tenderizer bottle as a salt shaker. Screw top keeps salt dry to the last grain.

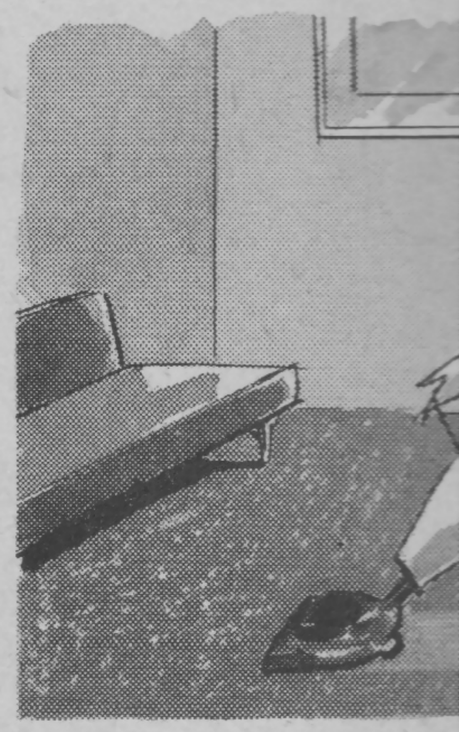


You can keep the younger generation from poking objects into open electrical sockets by covering the openings with easily removed masking tape or cellophane tape.

If you keep mothballs i punched numerous small work just as effectively a "candy"

If the furniture in a small room seems to jut out in assorted directions, enamel the furniture in a satin finish in the same color as the walls. Furniture and walls will blend and the room appear larger.

To make a portable hotbed, fill your child's discarded wagon with soil, plant seeds, labeling, of course, and cover with glass. Move wagon to catch all sun possible and pull to flower bed at transplanting time.



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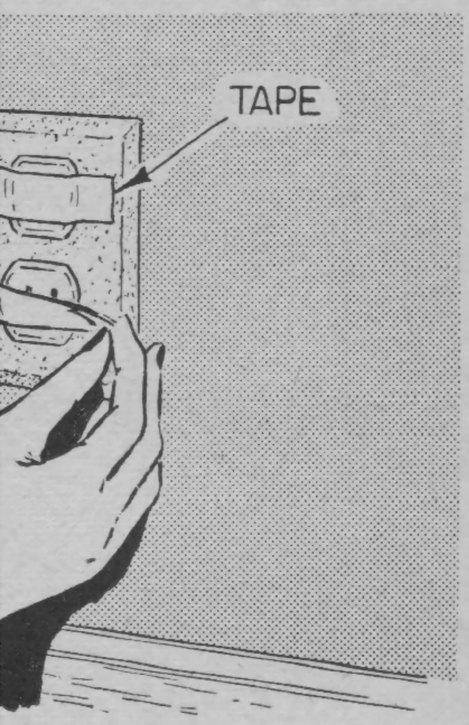

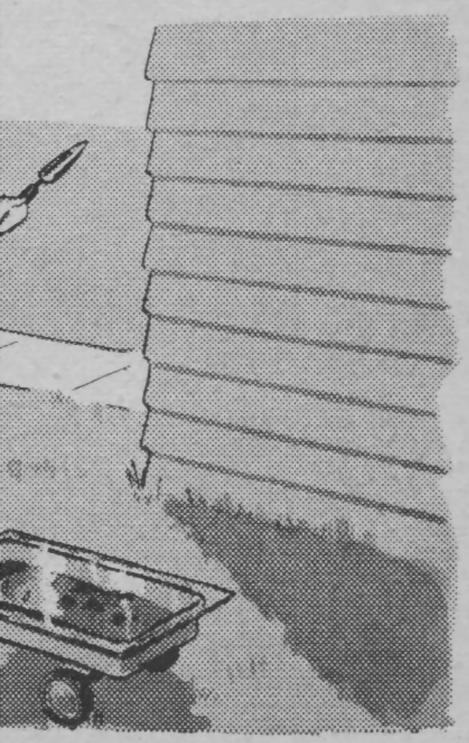

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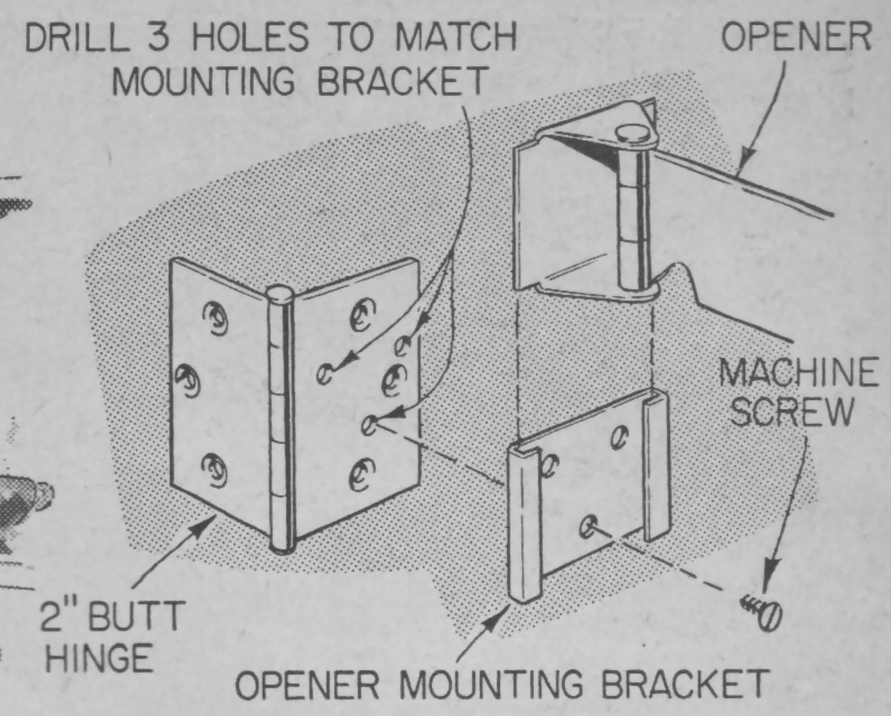
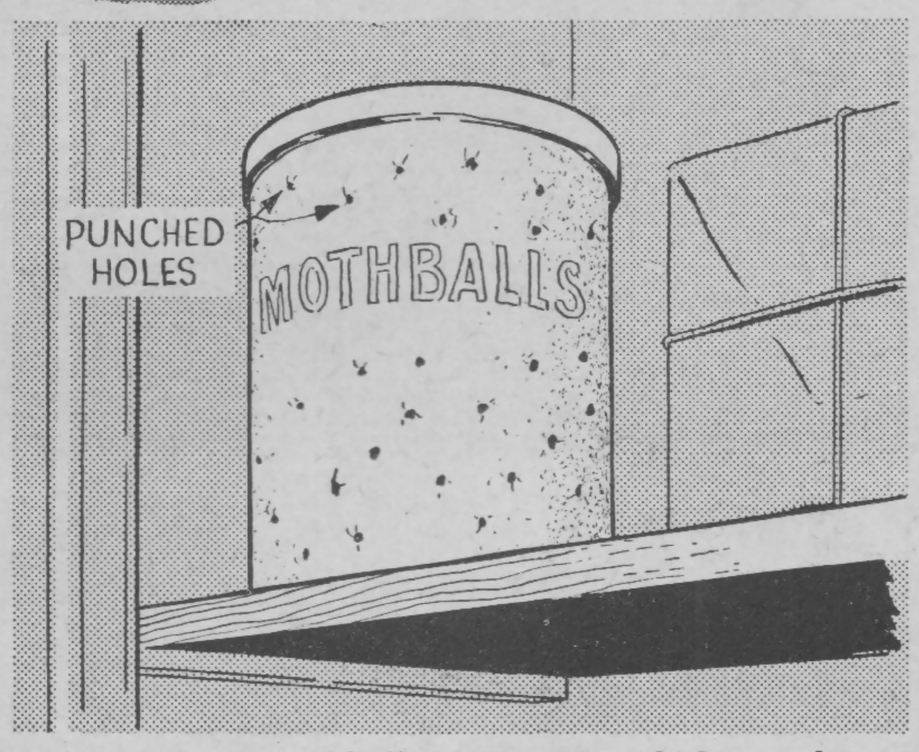
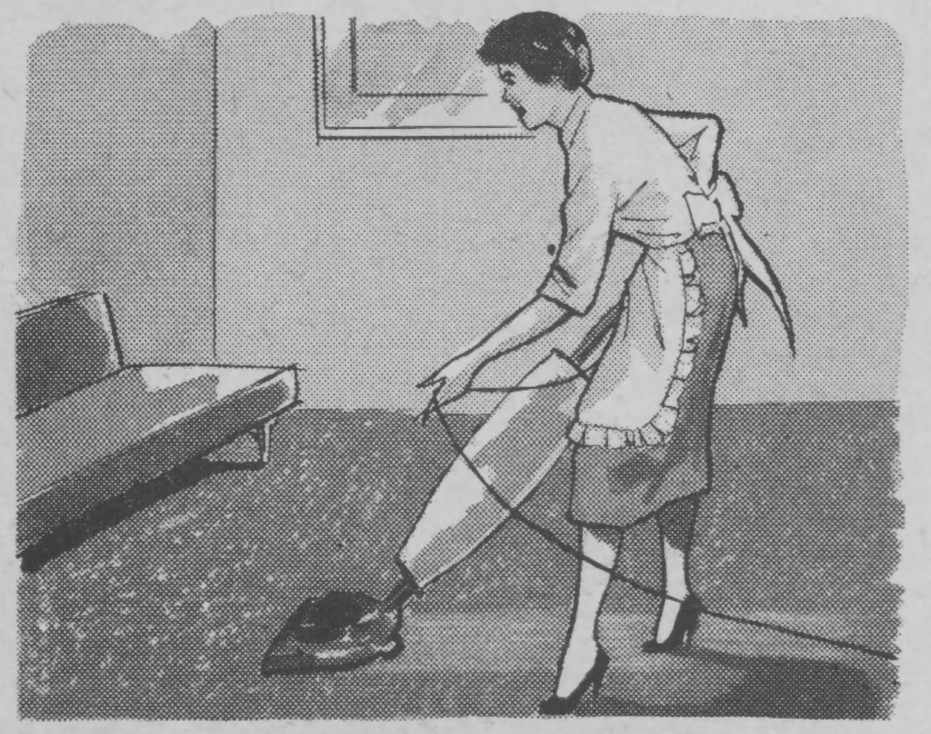


To make a double-hinge mount for a wall-type can opener, drill holes in one half of a 2-in. butt hinge to match the screw holes in the opener's mounting bracket, then fasten together with machine screws. Fasten bracket to inside of cabinet and insert opener, which will now swing out of sight when not in use.

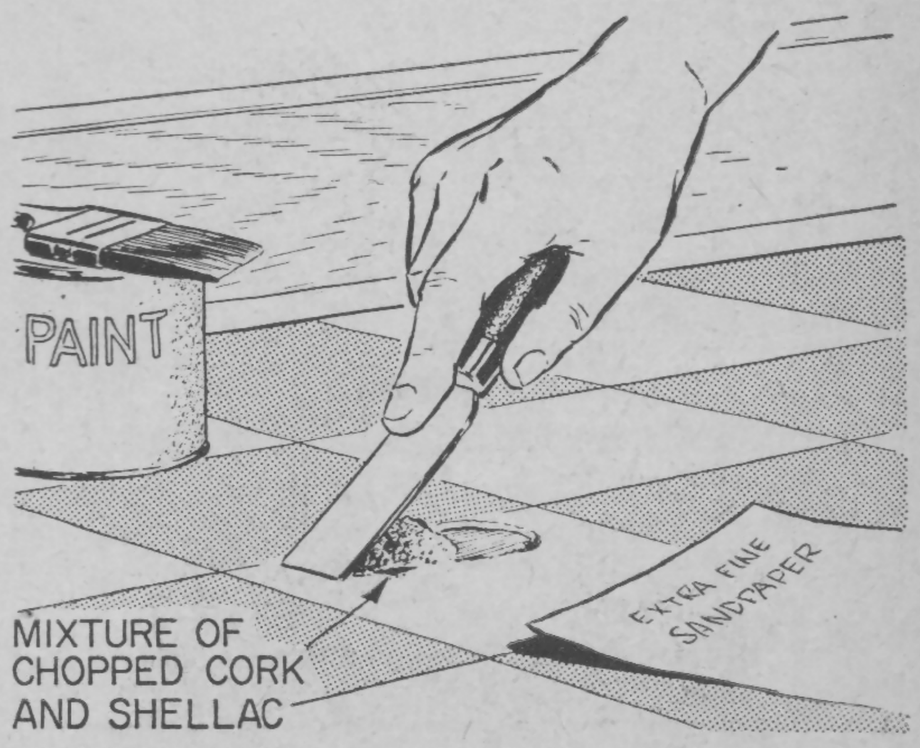


If you keep mothballs in cans in which you have punched numerous small holes, they can do their work just as effectively and still pose no promise of "candy" to children.

Use a nylon pastry brush to grease baking pans or to apply softened butter to bread for a crowd.



The weekly carpet vacuuming should consist of at least seven vacuum strokes over every foot of the carpeting surface. Sprinkle salt on carpets before vacuuming to loosen soot, and to insure a more thorough job.



You can mend small holes in linoleum by filling them with a thick paste made of finely chopped cork and shellac. Allow the paste to harden, then sandpaper the surface smooth and touch up with matching paint.

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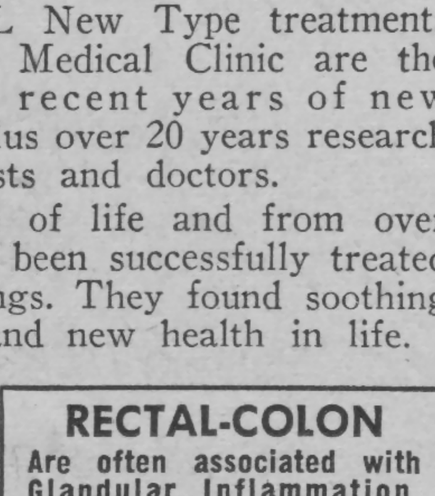

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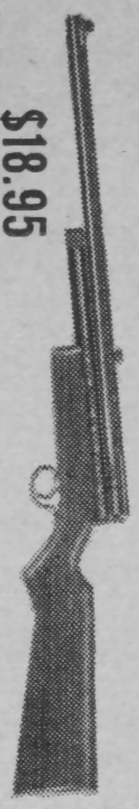

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269. SCREWBALL 11½-ft., five-passenger pram. Easy plywood construction, great seaworthiness. Powered by 10-12 hp outboard motors, "Screwball" planes. Beaches easily; can be transported atop autos. $1.50

270. SEA FLEA 10-ft. demon midget sailer (sails can be made at home). Hull weighs only 90 lbs.; easily dismantled spars, 15 lbs. Hair-trigger action of this surfboard sailboat best controlled by one man—but "Sea Flea" will carry two safely. Has non-sinkable hull. $1.50

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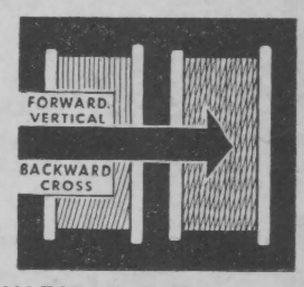

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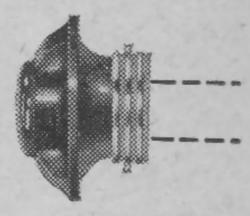

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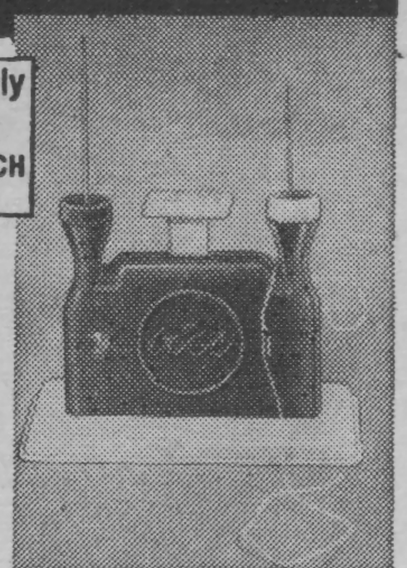

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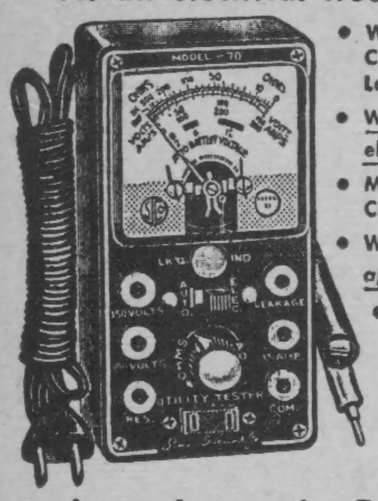

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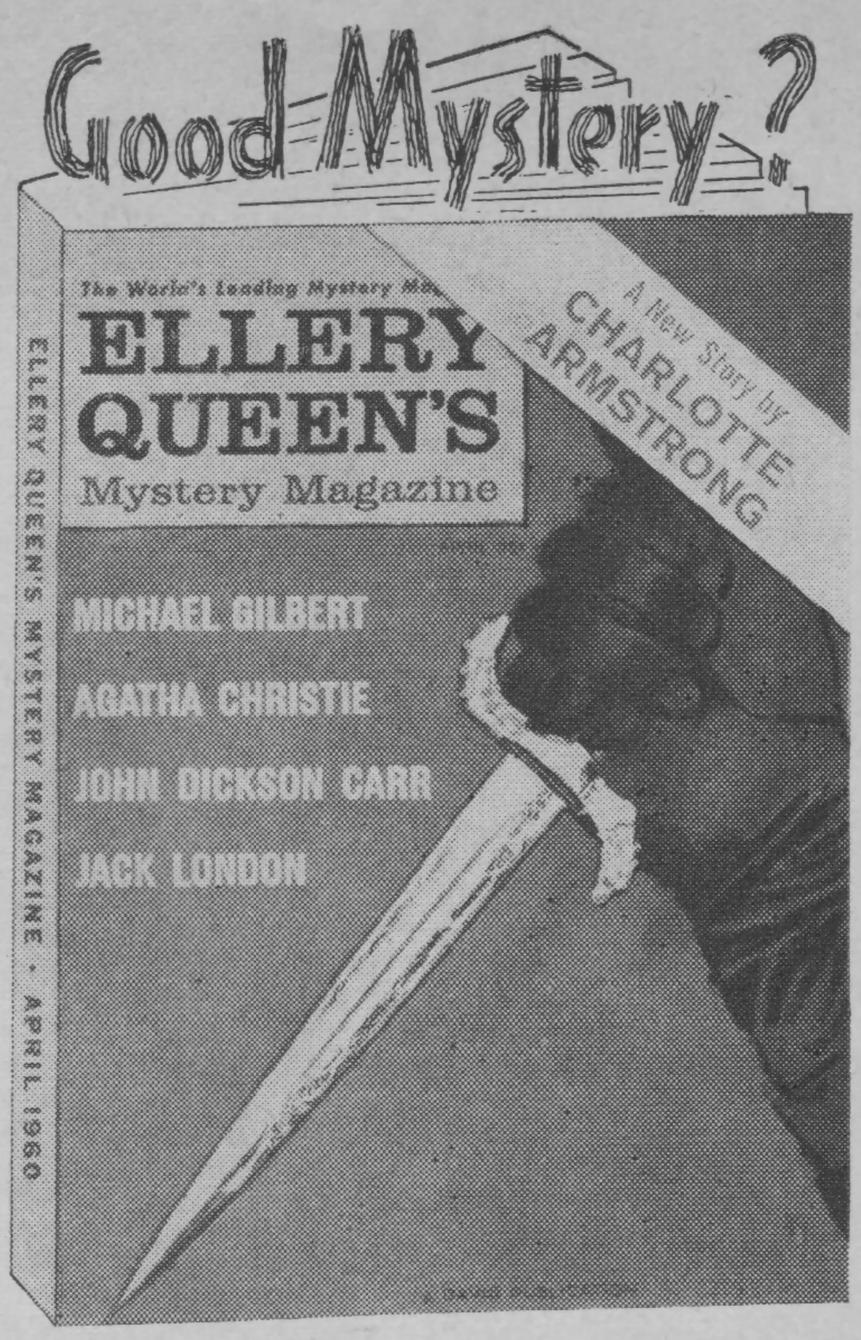

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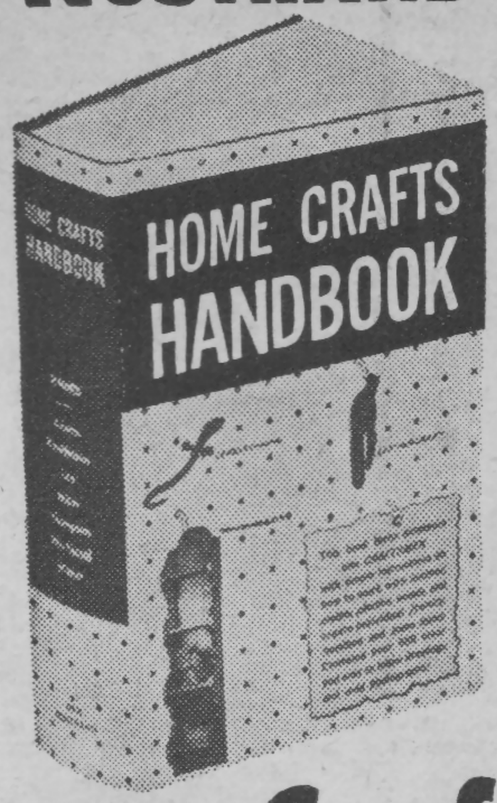

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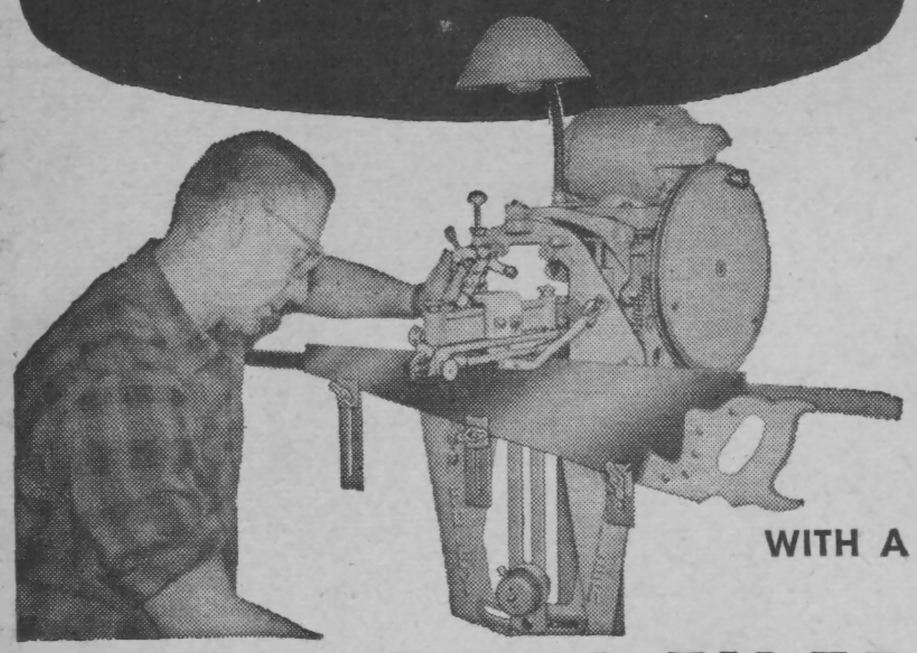

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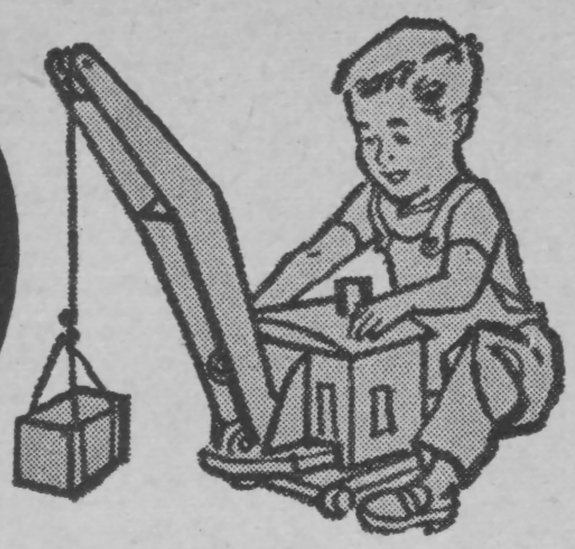

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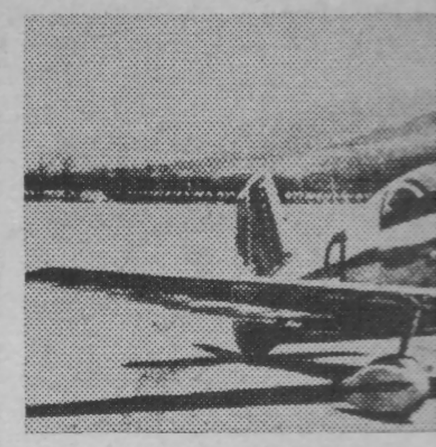

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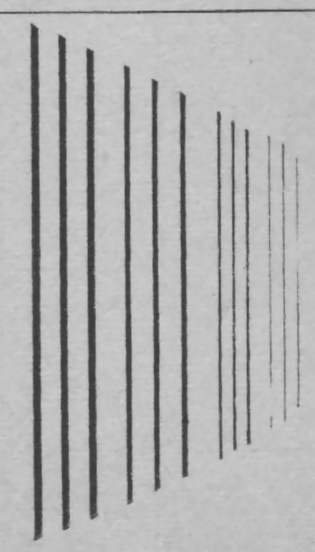

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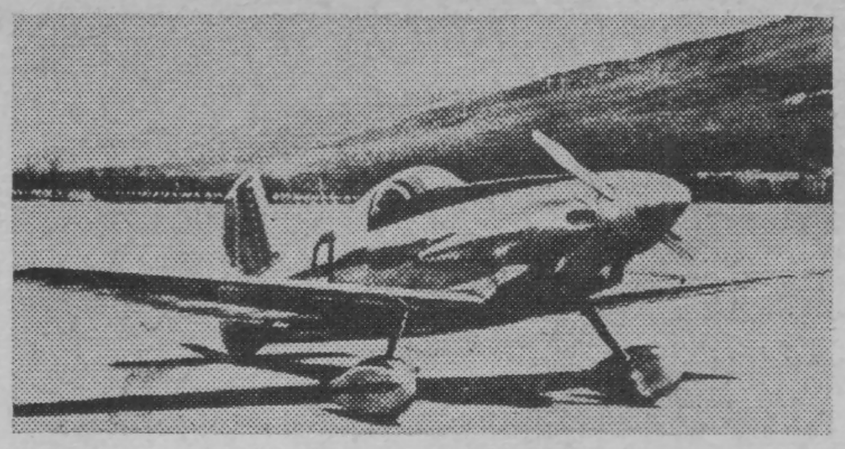

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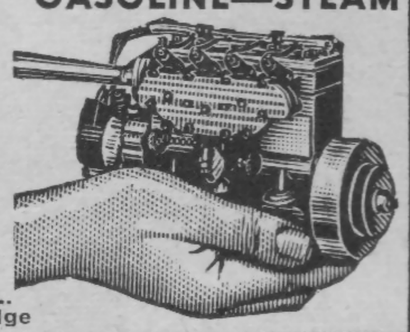
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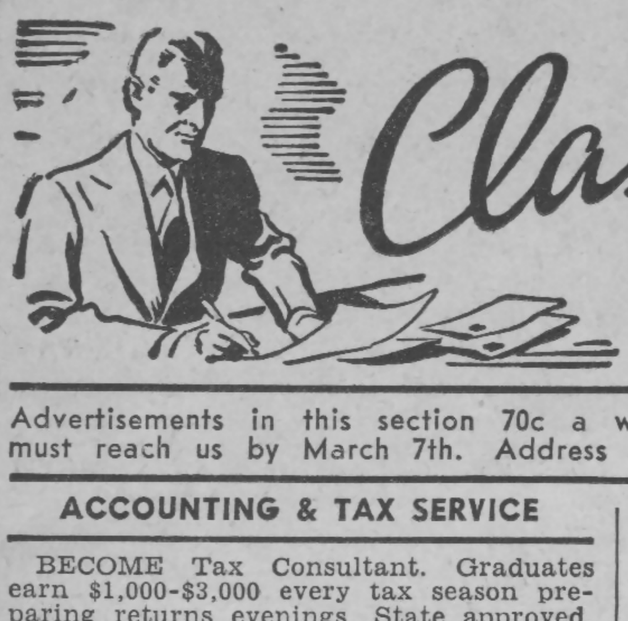

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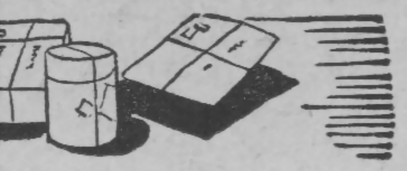

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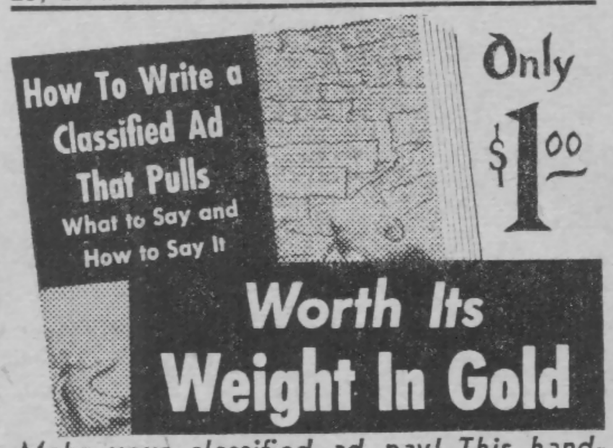

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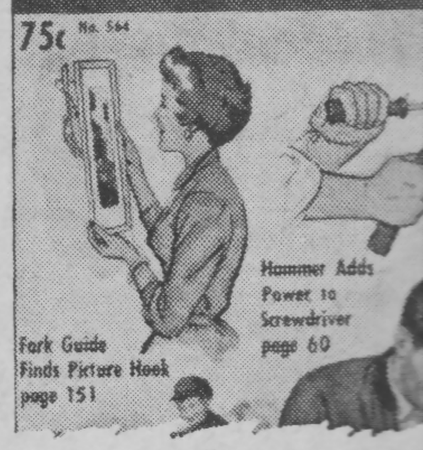

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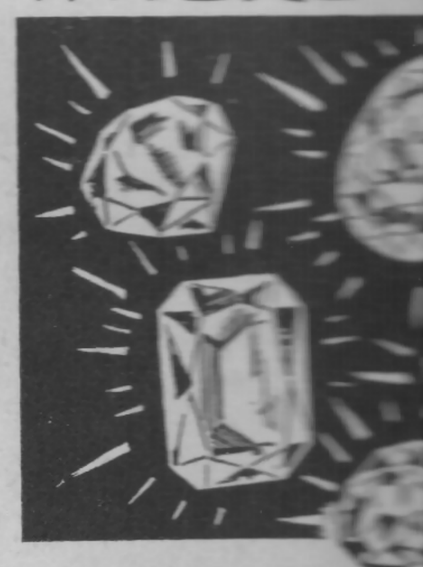

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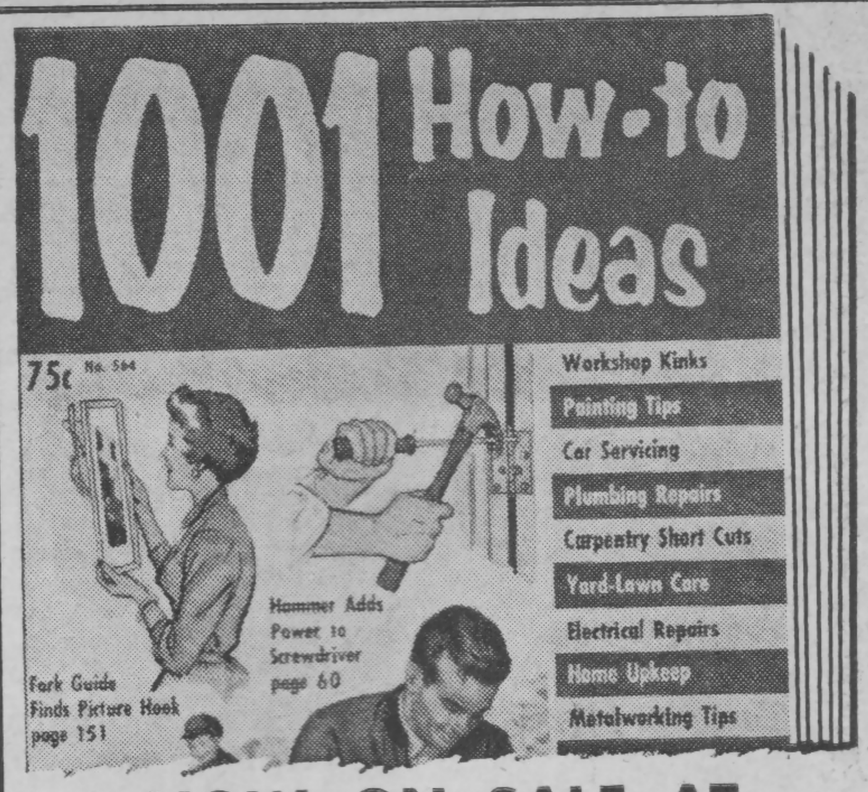

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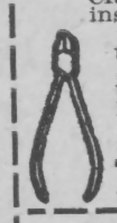

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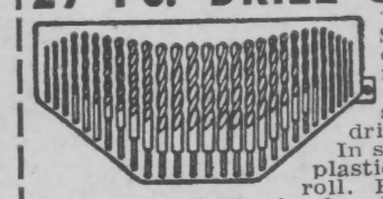

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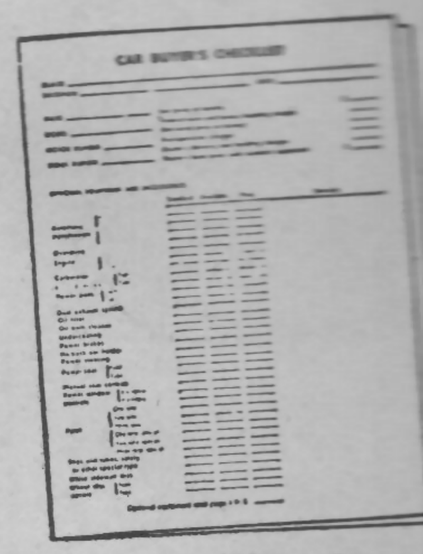

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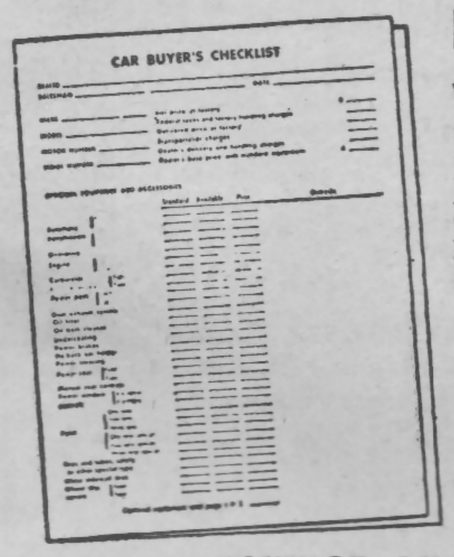

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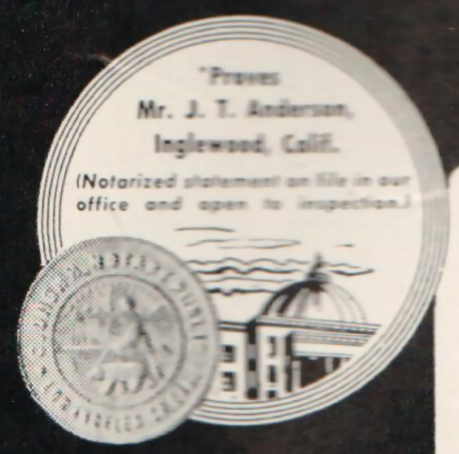

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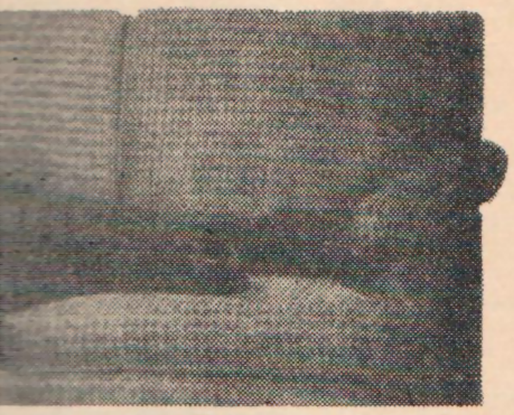

my little boy for wondering. It seemed
husband enjoyed was SLEEP! He would
ely worn-out, often he skipped supper
kind of companionship was this for his

rgetic man. But for some reason he now
I wondered what I could do to help him.
fe ad in a magazine. It told how many
and women could easily lose their pep
ged deficiency of essential vitamins and
vealed that thousands of men and women
ality through the famous Vitasafe Plan.
husband too.
pply that was offered, and when they
ing one a day. Before long my husband
ppy, energetic and wide awake!
and as I did mine, mail the postcard for
risking a penny.

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vanish! Not a trace remains! Then, like a
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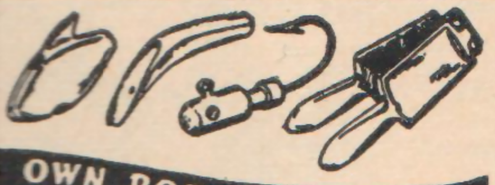

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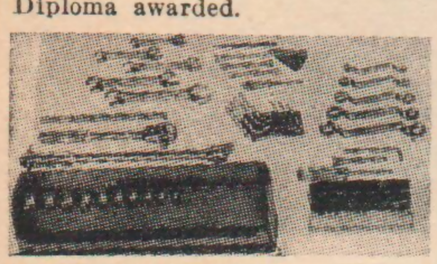

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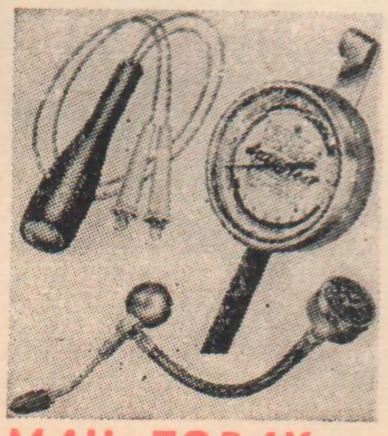

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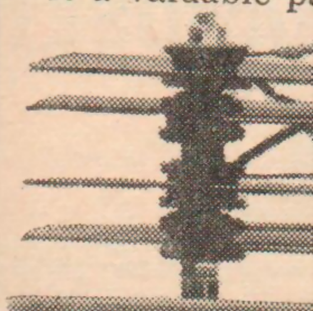

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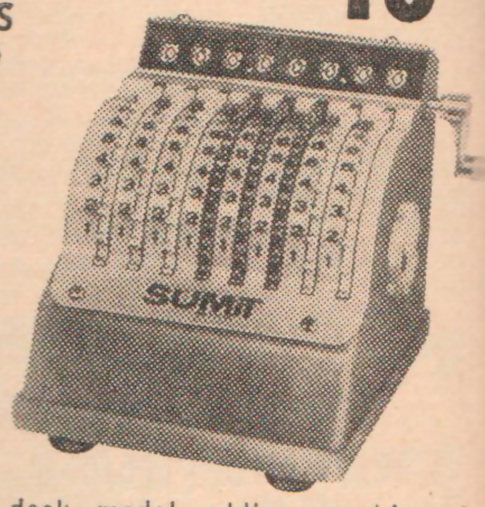

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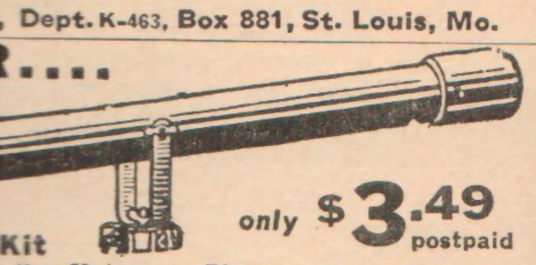

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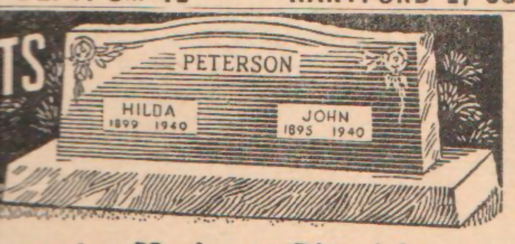

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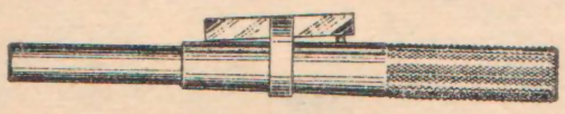

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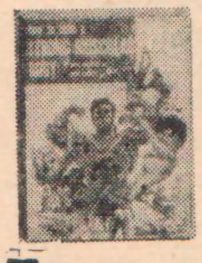

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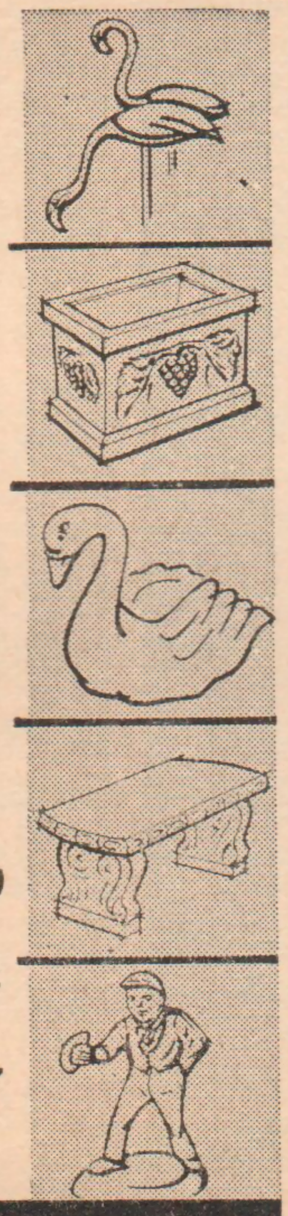

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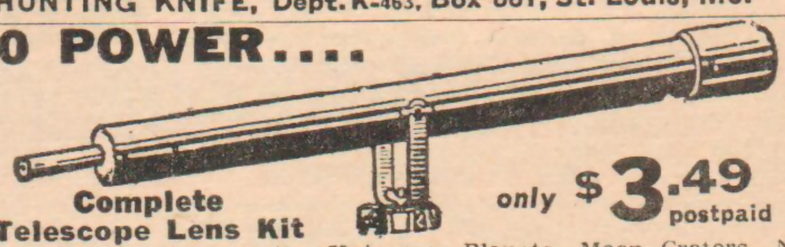

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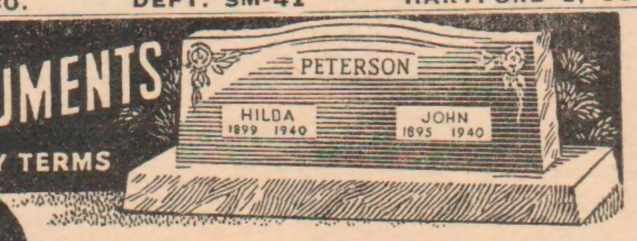

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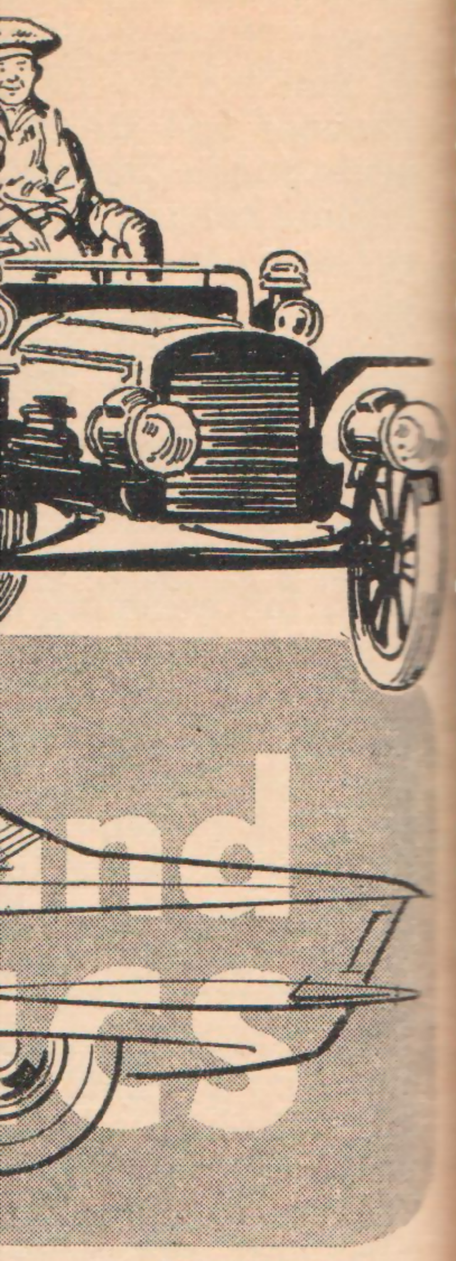

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...refinishing is to lift a corner of the rug and notice the difference between exposed and protected parts of the floor.

The method you then use to refinish the floor depends upon the condition of the finish on your floor. For example, if your floor has always been maintained by dusting or vacuuming and rewaxing, the original finish is probably in good shape and the darkened appearance of the

1

Evidence of the cleaning action of this safe yet powerful bleach-cleaning formula is shown by comparison between cleaned and uncleaned areas of the floor above.

2

Paste wax polished with an electric floor polishing machine provides the most durable and lasting protection for hardwood floor finishes.

floor may be due to dirt and grime embedded in the layers of old wax only. Removing the old wax and cleaning the original finish usually lightens and brightens such a floor.

If, on the other hand, your floor has been maintained by mopping and washing with water and detergent, the original finish has probably been washed off in places and the dirt and grime embedded in the finish and wood itself, turning it to a dirty gray. The only way to refinish such a floor is by using the floor cleaning formula described later.

Removing Old Floor Wax. Use turpentine or oil-paint thinner (sold under various trade names as an inexpensive substitute for turpentine) and #2 steel wool to remove old floor wax. Dip a pad of steel wool into the paint thinner and hand scrub the floor, working on a small area at a time. Wipe up the dirty, dissolved wax with clean rags and go

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The method you th
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For example, if your
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